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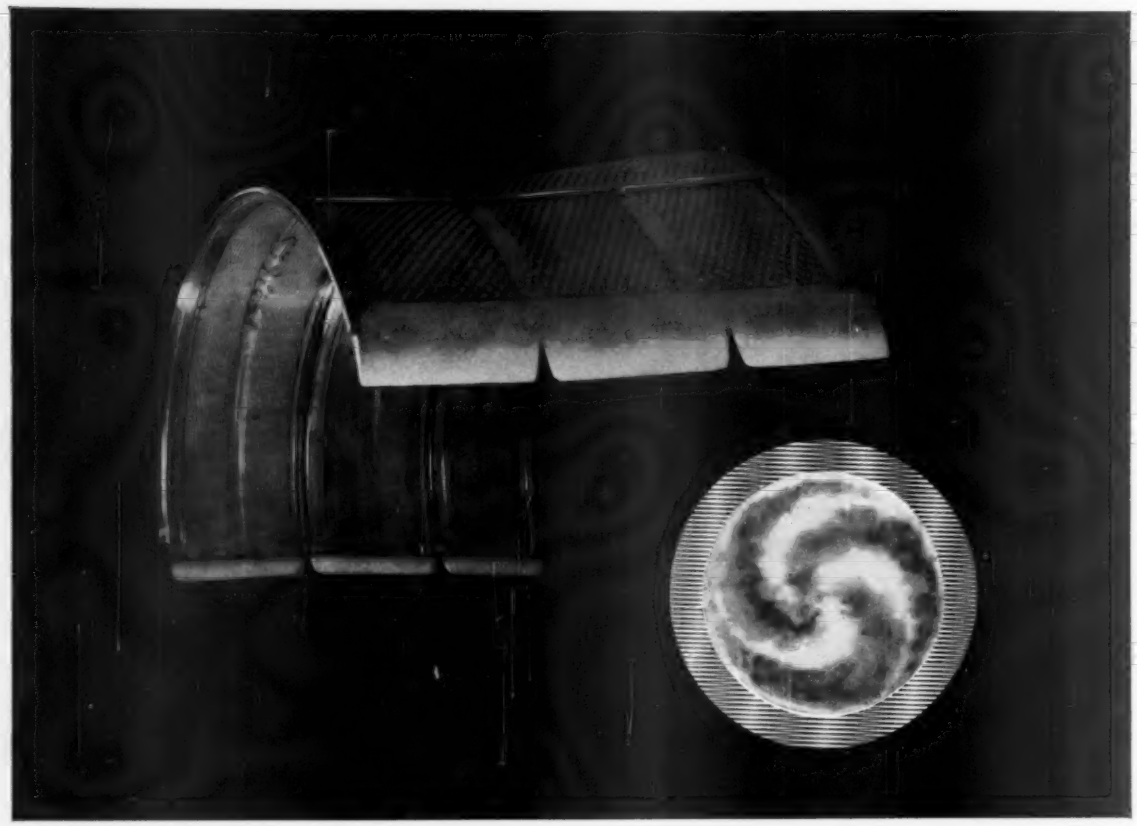

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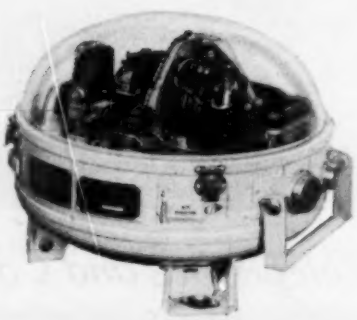

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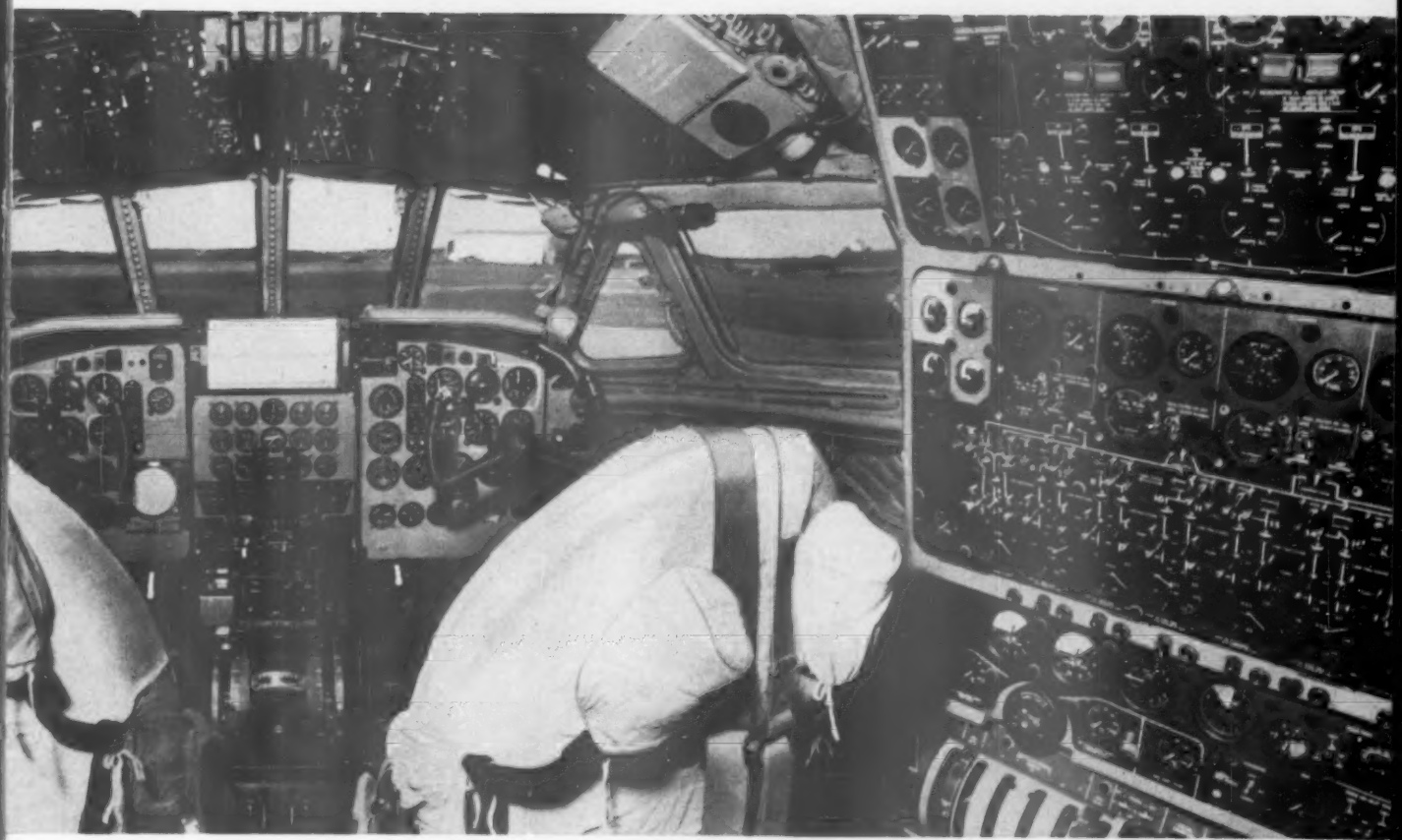

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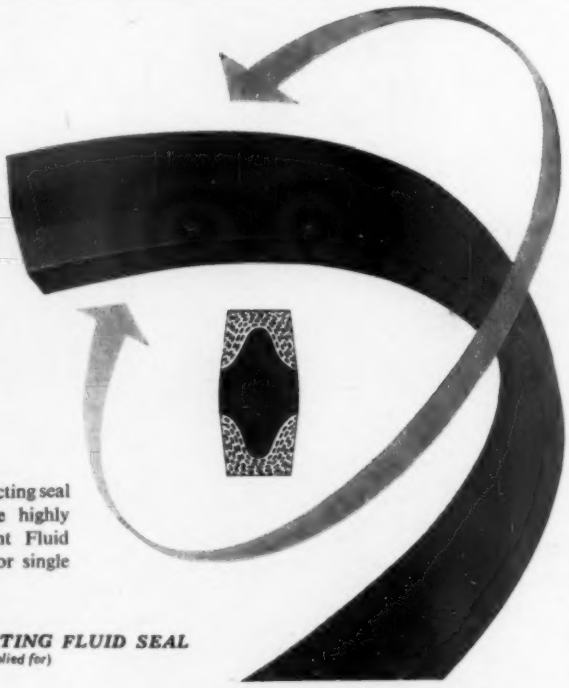

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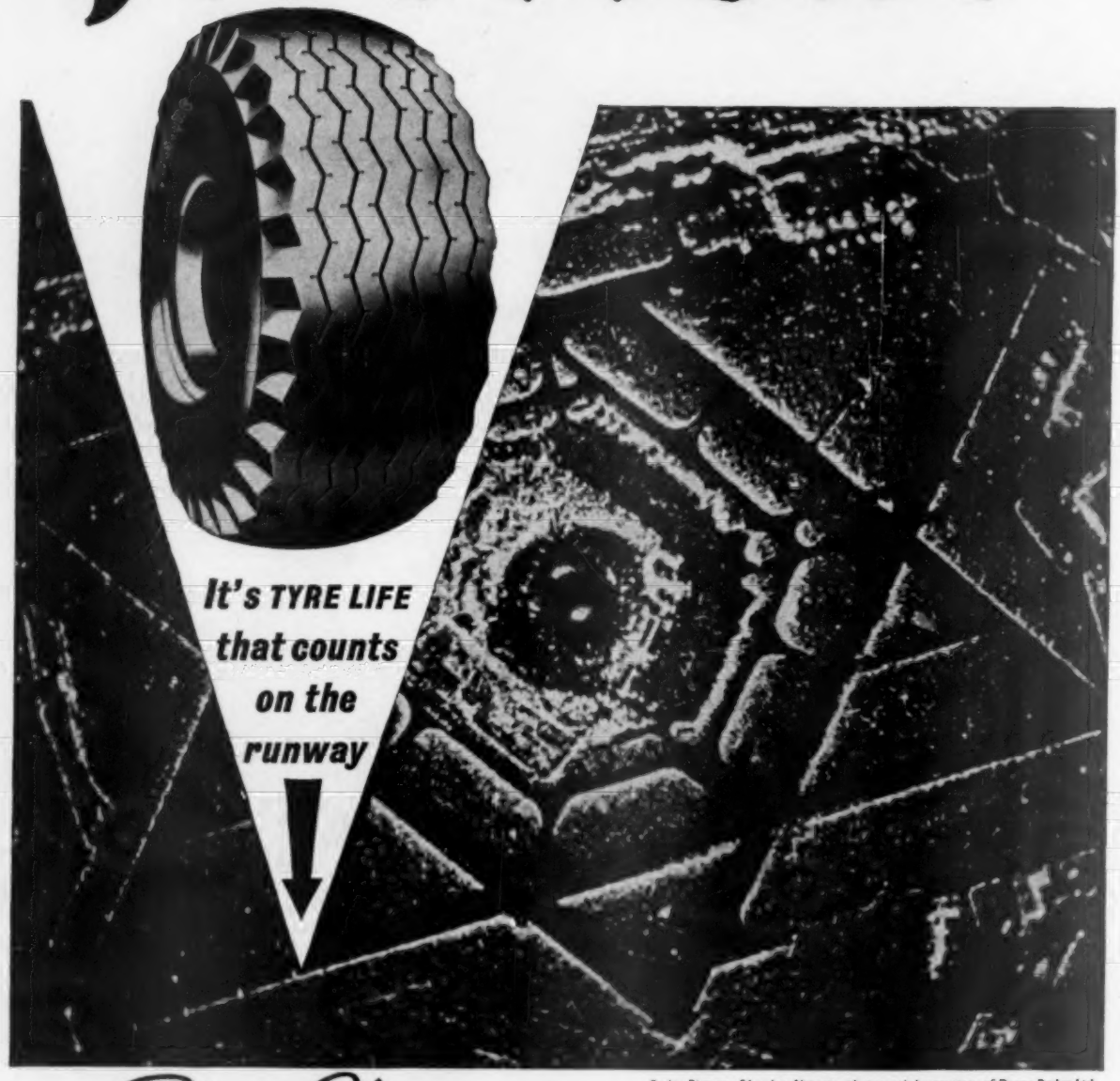

Radar Picture of London Airport—photograph by courtesy of Decca Radar Ltd.

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an exercise in which 4000 troops and 120 vehicles were flown from Britain to fight in the Libyan desert, relied largely for the short-range support on the ubiquitous Whirlwind helicopter. About 100 tons of supplies were moved up each day by six fixed-wing aircraft and 12 Whirlwind helicopters.

The Whirlwind, powered by the Alvis Leonides Major, is in front-line service with army, naval and air forces. It carries 5 fully-equipped troops or payloads up to 1100 lbs. inside the cabin or slung externally.

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THE AEROPLANE and ASTRONAUTICS

VOLUME 98 NUMBER 2534 MAY 13, 1960

Spatial Reconnaissance

In recent months, a good deal has been said and written about the development of Earth-satellite vehicles especially designed and equipped for reconnaissance duties. No great imagination is required to appreciate that this particular application of astronautical science, in addition to opening up considerable technological possibilities for widening the scope of reconnaissance activity, is likely also to raise some important international issues in relation to space sovereignty.

It has been known for some time that development work is in progress, in the United States, on a polar-orbiting reconnaissance satellite intended to obtain, record and transmit military intelligence information. Few details of this project—which goes under the name of Samos—have been given. First launching of the satellite is planned for this summer. A companion satellite, Midas, which has already reached the launching stage (although the first attempt in February proved unsuccessful), is intended for reconnaissance of another sort and carries infra-red detection equipment to give advance warning of ICBM launchings.

At the present stage of the astronautical art, it is conjectural whether the degree of resolution available from the surveillance equipment in Samos will be high enough for detail interpretation. But given favourable conditions, and the prescribed stable orbit, development satellites of this type could presumably locate the position of large objects of military interest.

After the embarrassing episode of the U-2, America's plan to launch Samos over the poles—which would, inevitably, take it over Soviet territory—will doubtless undergo some searching examination. But whatever the outcome of such deliberations, it is high time that the vital matter of space sovereignty should receive the closest possible attention in the Council chamber of the United Nations.

Kidlington Reflections

Schoolboys busily engaged in taking notes of train numbers are conspicuous at every railway station. There is something worrying in the thought that the young should be interesting themselves in such old-fashioned machinery as that which all too often is used to convert the energy in coal into tractive effort. Steam locomotives, as used by British Railways, are certainly picturesque but cannot be recommended as examples of modern engineering efficiency.

How refreshing, after a long cross-country journey during which such activities had been all too obvious, to arrive at our destination where some fine examples of modern engineering efficiency were on show. This was at Kidlington, which has undergone rejuvenation at the hands of the Pressed Steel Company. In the glorious weather of last week-end the trim grass airfield surface was setting off a wonderful variety of aeroplanes, thanks to the enterprise of Shackleton *père et fils* and their efficient team.

Scores of the rising generation were having a splendid time jotting down the finer points of modern light aircraft. It was surprising how many were using telescopes to pick up newcomers on their way in by air. The enthusiasm of these boys (we noticed no girls) was a reminder of the responsibility we all have to see that adequate means of getting the youngsters into the air are effectively provided. If we do this, Great Britain may yet get enough enthusiasts to build up a light aeroplane industry of its own again.

Editor - - - - - THURSTAN JAMES
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Matters of Moment

Remote Control Indeed

A REMARKABLE achievement by the Jodrell Bank radio-telescope team was in the news last week to underline progress made in long-distance communications. The 150-w. transmitter of Pioneer V was successfully switched on for the first time—no less than eight million miles away—by a command signal from Jodrell Bank on May 8. Previously, a 5-w. transmitter had been used to secure information from the probe which had supplied 109-hr. of telemetered information on cosmic radiation, charged particles in space, magnetic field phenomena, and solar flares.

According to NASA, "Everything is working according to schedule, but there seems to be a slight deterioration in the chemical batteries." The 150-w. transmitter, weighing only 5 lb., will be switched on for two to three minutes every six to eight hours to conserve the batteries which are recharged by solar cells.

Still Higher Exports

WITH a total value of £15,713,232, the March figure for Britain's aero-exports works out at an average daily rate of more than £½ million. This is reported by the S.B.A.C., in its latest export sales list, as being the highest March figure to date and the third largest monthly figure achieved. For the first quarter of 1960, the grand total has been £39,340,339.

During March, the export of complete aircraft accounted for £5,315,367; aircraft parts for £2,452,286; new aero-engines (86) for £3,199,959; "other than new" aero-engines (120) for £2,272,969; aero-engine parts for £1,794,405; electrical parts and appliances for £357,244; tyres for £84,882; and aeronautical instruments for £236,120.

For the first quarter of the year the sale of complete aircraft amounted to £12,805,104; aircraft parts accounted for £7,054,417; new aero-engines (224) for £7,140,392; "other than new" engines (327) for £5,335,211; aero-engine parts for £5,125,050; electrical parts and appliances for £955,989; tyres for £248,533; and instruments for £675,643.

The powerplant industry has made a very healthy contribution to this export income during the first three months of the year. Aero-engines and parts sold abroad in March were worth £1 million more than in the previous record month—October, 1959. The aero-engine export total for the January-March period was valued at more than £17½ million.

Honoured by the R.Ae.S.

AMONG the customary business conducted at the annual general meeting of the Royal Aeronautical Society is the presentation, by the retiring president, of various medals and prizes to those who have been awarded them for their papers and lectures during the past 12 months. This important ceremony was performed on May 5 by Mr. P. G. Masefield before he handed over his chain of office to the new president, Dr. E. S. Moult (see THE AEROPLANE AND ASTRONAUTICS for May 6). As is usual at this induction ceremony, the retiring president was presented with a handsome plaque to commemorate his term of office.

R.Ae.S. PRESENTATION.—Mr. D. J. Farrar, chief designer (guided weapons) at Bristol Aircraft, receives the Simms Gold Medal from the Royal Aeronautical Society's retiring president, Mr. P. G. Masefield, on May 5; on Mr. Masefield's left is the new president Dr. E. S. Moult.

First among the 1960 awards is the Simms Gold Medal, which has gone to Mr. D. J. Farrar, O.B.E., M.A., F.R.Ae.S., chief designer (guided weapons) of Bristol Aircraft, Ltd., for his paper "The Bloodhound." This medal—first presented in 1926—is awarded for "the most valuable contribution read before, or received by, the Society on any subject allied to aeronautics."

For his paper on "Safe Mechanisms," Mr. R. Hafner, F.R.Ae.S.—formerly chief designer (helicopters), Bristol Aircraft, Ltd., and now special director (Bristol) of Westland Aircraft—has received the George Taylor (of Australia) Gold Medal.

For the most valuable contribution on applied aerodynamics, published in one of the Society's publications, Mr. E. C. Maskell, M.A., A.F.R.Ae.S. and Dr. J. Weber, A.F.R.Ae.S., of R.A.E., received the Edward Busk Memorial Prize for their paper on the aerodynamic design of slender wings. The Orville Wright Prize went to Mr. R. Hicks, Ph.D., M.Sc., of the G.E.C. Simon-Carves Atomic Energy Group, for two papers considered to qualify as "the most valuable contribution to the Society's *Aeronautical Quarterly* on some subject of a technical nature in connection with aeronautics."

To Mr. P. Lloyd, C.B.E., M.A., F.R.Ae.S., deputy director of N.G.T.E., went the Herbert Ackroyd Memorial Prize for "Some Aspects of Engine Noise," as the most valuable contribution to the Society's publications on aircraft propulsion. The

PRIZEWINNERS.—Among those receiving awards at the R.Ae.S. on May 5 were (left to right), Mr. C. J. Wood; Prof. A. W. Morley; Mr. C. L. Bore; Mr. R. Hafner; Mr. P. Lloyd; Mr. E. G. C. Burt; Dr. J. Weber; and Mr. E. C. Maskell.

Photographs copyright "The Aeroplane and Astronautics"

J. E. Hodgson Prize went to Prof. A. R. Collar, M.A., D.Sc., F.R.Ae.S., F.I.A.S., for his paper "Aero-elasticity—Retrospect and Prospect."

The Branch Prize went to Prof. A. W. Morley, M.Sc., Ph.D., Whit.Sch., A.C.G.I., F.R.Ae.S., for his paper given before the Luton Branch entitled "Notes on Air Breathing Engines for Supersonic Flight." Mr. E. G. C. Burt received the Navigation Prize for a paper on "Theoretical Principles of Guided Missile Systems." Mr. D. G. Drake, B.Sc., Grad.R.Ae.S., won the Usborne Memorial Prize for Graduates and Students for his paper on "Quasi Steady Derivatives for the Subsonic Flow Past an Oscillating Aerofoil in a Porous Wind-tunnel." And the Pilcher Memorial Prize went to Mr. C. L. Bore, B.Sc.(Eng.), Grad.R.Ae.S., for his paper "Some Practical Aspects of Kinetic Heating Calculations." C. J. Wood received the N. E. Rowe Medal.

The Air Minister at Oxford

LINKS between the Universities and the Royal Air Force have always been close. This is not hard to understand when one recalls the background of those who played important parts, not only at the Royal Aircraft Factory in the days of the R.F.C. but in developing aerodynamics at a time when so much essential research into that science had to be done in the air on the aircraft themselves. In times of emergency the advantages that stem from the closeness of the links between University and Service are manifest to everybody; in peacetime such benefits are apt to get overlooked and denigrated.

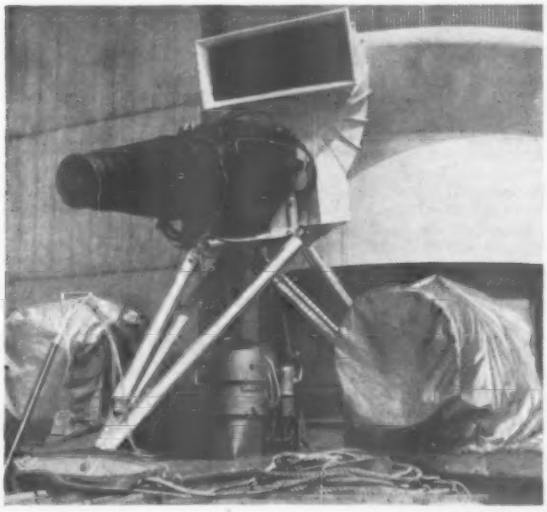
Consequently, the Royal Air Force is at pains to emphasize the high esteem in which its holds the relationship. Thus this year prizes at the annual dinner of the Oxford University Air Squadron were presented by the Secretary of State for Air in person. For the second year in succession the Flying Proficiency Trophy was won by Mr. Colin M. Labouchere who, it may be recalled, did so well in the Lockheed competition at Baginton last year. Only once previously since it was presented by Sir John Siddeley in 1933, has the trophy been won by the same member two years running. The Hack Trophy for the best all-round member went to Mr. Ian Duncan-Brown.

Before making the presentations on May 6, the RT. HON. GEORGE WARD had gone to some pains to make clear that the Government's decision about Blue Streak did not mean the end of the independent contribution by this country to the deterrent. The intention of the Government, Mr. Ward made clear, is to stand by this policy until disarmament is achieved. He gave it as his own view that British ingenuity and skill would make an appropriate contribution by means of Blue Streak to space exploration. He emphasized that manned aircraft are going to have a much longer life than was thought even a little while ago. The existence of the British V-bomber force is immensely valued by our allies. Its continued existence means that the Service will be able as far ahead as can be seen to offer adventure, comradeship and security to men of moral courage who love to fly.

The guests, who included the first C.O. of the Squadron, Air Chief Marshal Sir Guy Garrod and the Air Secretary, Sir Theodore McEvoy, were welcomed by the retiring C.O. of the Squadron, WG. CDR. A. J. DOUCH. He made special reference to Air Vice-Marshal MacNeece Foster to whose part in building up the spirit of the Royal Auxiliary Air Force, his former pupil, Mr. George Ward, had also paid tribute in his speech. In welcoming the guests which he did warmly and with wit, the Commanding Officer did not miss the chance to draw attention to certain deficiencies in radio aids at Bicester. "It was a pity," he said in reference to these matters, "that the Squadron had to stop flying when it began to rain."

After MR. G. R. G. MURE, the Warden of Merton, had disclosed the unfair methods used to defeat him at golf and then very generously, in view of this disclosure, set out the advantages which the existence of the Squadron confers on the University, an O.U.A.S. member, MR. D. R. BOUWER, replied.

He is a South African who took a degree in Physics and Chemistry, we believe, before going up to Oxford to read Politics, Philosophy and Economics. He reminded his audience of his anti-British background and then in lighter vein recalled that his ability to play rugger had been the open sesame to membership of the Squadron. It was also, we gather, the cause of some excitement when he came to cross the border into Wales. He concluded his speech with a fervent plea that the advantages of membership of the Squadron might be more widely conferred by the Air Ministry on members of the University who came from the Commonwealth and he included those from Ghana and Nigeria among them.—T.J.



Leaving B.O.A.C.

AFTER four years as deputy chairman of B.O.A.C., Sir George Cribbett resigned from this post for health reasons at the end of April. This intention had been announced in January. Whilst serving with the Corporation his principal pre-occupation had been with his additional duties as chairman of B.O.A.C. Associated Companies.

Sir George's direct concern with air transport began during the 1939-45 war, when, after returning from service in Washington with the R.A.F. delegation he helped in formulating U.K. post-war policy. He was a U.K. delegate at the 1944 Chicago conference which resulted in ICAO and subsequently led the U.K. delegation at many international conferences. He became Deputy Secretary to the M.C.A. in 1946.

Brazilian Tour

GENERAL F. A. CORRES DE MELLO, Brazil's Air Minister, has been among the distinguished passengers carried in the Handley Page Dart Herald during its present South American visit. This tour is the fourth in a series which, within 12 months, has taken Dart Heralds over 160,000 miles to 47 countries. Commonwealth members of the Diplomatic Corps in Brazil flew in the aircraft from Rio de Janeiro to Brasilia for the inauguration of Brazil's new capital city. Before returning to England on May 24 the Herald will be flown to Argentina and show its paces to the Argentine Air Force.

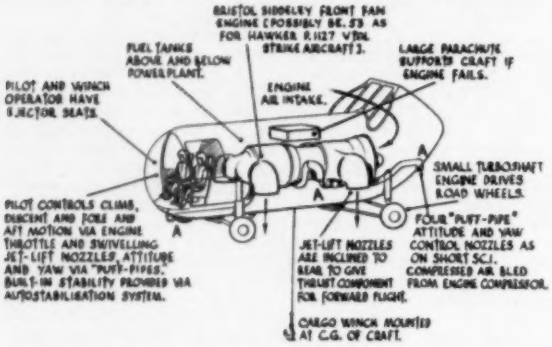
MORE POWER.—A Blackburn Marboré turbojet engine has now been installed on the Saunders-Roe SR-N1 Hovercraft to give more forward thrust and to increase its speed. Above, a close-up of the additional powerplant; the covered drums are fuel tanks. Speeds of the order of 60 m.p.h. have now been accomplished.

VTOL from Filton

BRISTOL SIDDELEY recently gave some new information about its wingless jet-lift vehicle, which has been nicknamed the "flying pig." This project was first mentioned by Dr. Hooker, technical director (aero) of the company, in the James Clayton Lecture last December. It is, at present, only in the design-study stage; a possible layout is shown below.

Basically, the "flying pig" is a logical development from VTOL research craft such as the Rolls-Royce Flying Bedstead. Although few details of the Bristol Siddeley vehicle have been released, its shape gives relatively clear indications of its propulsion and control system.

An economical ducted-fan engine with a thrust of about seven times its installed weight is an essential requirement for this vehicle. According to Bristol Siddeley, the engine proposed delivers nearly 7 tons of thrust, or about 15,500 lb.; it is probably an up-rated version of the BE 58 which has a thrust/weight ratio of 5.6 and a full-thrust s.f.c. of 0.572 lb./lb./hr. The BE 58 is a civil variant of the military BE 53 which is to be installed in the Hawker P.1127 VTOL strike aircraft.


BRISTOL SIDDELEY FRONT FAN ENGINE (POSSIBLY BE.53 AS FOR HAWKER P.1127 VTOL STRIKE AIRCRAFT).
FUEL TANKS ABOVE AND BELOW POWER PLANT.
LARGE PARACHUTE SUPPORTS CRAFT IF ENGINE FAILS.
PILOT AND WINCH OPERATOR HAVE EJECTOR SEATS.
ENGINE AIR INTAKE.
SMALL TURBOSHAFT ENGINE DRIVES ROAD WHEELS.
PILOT CONTROLS CLIMB, DESCENT AND FORE AND AFT MOTION VIA ENGINE THROTTLE AND SWIVELLING JET-LIFT NOZZLES, ATTITUDE AND YAW VIA "PUFF-PIPES." BUILT-IN STABILITY PROVIDED VIA AUTOSTABILISATION SYSTEM.
FOUR "PUFF-PIPE" ATTITUDE AND YAW CONTROL NOZZLES AS ON SHORT SC.1. COMPRESSED AIR BLED FROM ENGINE COMPRESSOR.
JET-LIFT NOZZLES ARE INCLINED TO REAR TO GIVE THRUST COMPONENT FOR FORWARD FLIGHT.
CARGO WINCH MOUNTED AT C.G. OF CRAFT.

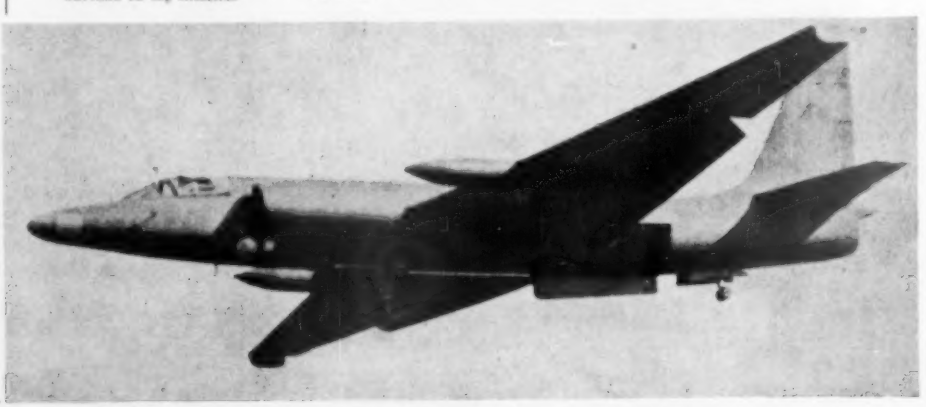
The Bristol Siddeley jet-lift vehicle has been proposed as a military flying-crane. It would have an empty weight of about 2½ tons; the total weight, including fuel and load carried, would approach 7 tons. Cruising at 230 m.p.h., it could carry a two-ton load over 150 miles, or a one-ton load for 190 miles. Fuel consumption in carrying two tons for 150 miles would be about two tons; in carrying a one-ton load for 190 miles the vehicle would consume about three tons of fuel.

Apparently, there are bifurcated outlets from the front-fan and turbine exhausts; they discharge downwards through jet-lift nozzles, evenly disposed about the centre of gravity, which can presumably be inclined slightly forward or aft to provide braking or propulsive thrust components. A four-point "puff-pipe" control system for attitude and yaw is used. The system probably uses compressed air bled from the ducted fan engine. Artificial stability is provided via an autostabilization system, probably with duplicated or triplicated channels.

Crew members sit in ejector seats; a large parachute is also provided to lower the vehicle if there is an engine failure. A small turboshaft engine is installed so that the craft can be driven as a road vehicle.

The vehicle is much more compact and possibly cheaper than a crane helicopter which could lift about four tons. On the other hand, it has a prodigal fuel consumption, is likely to be very noisy and in the form shown might be difficult to operate with jet effluxes discharging toward the load carried.

This recent photograph of the U-2, from "Air-review," shows it now to have pinion fuel tanks. Left, below, is an impression of the Russian M-2 surface-to-air missile.



The U-2 Incident

PROMINENT in the news last week-end was the shooting down of an American Lockheed U-2 reconnaissance aircraft over Russia on May 1. It was claimed that the U-2 had been brought down from a height of about 12 miles near Sverdlovsk, 1,200 miles from the Afghan-Soviet border; a ground-launched missile was said to have been used. According to Russian reports the aircraft had photographed Soviet airfields and had recorded Russian radio and radar transmissions; the pilot was captured alive.

After an initial denial that the aircraft had intentionally flown over Russia, the U.S. admitted that it had done so in a statement released on May 8. "It appears that in endeavouring to obtain information now concealed behind the Iron Curtain, a flight over Soviet territory was probably undertaken by an unarmed civilian U-2 plane."

By all accounts, the U-2 seems to be a highly successful reconnaissance aircraft; it is equipped for radar mapping, photographic and radar reconnaissance and radiation sampling. Although it has been in service for several years, it has always been a "mystery ship" with high-altitude weather research under NACA (later NASA) auspices given as its main rôle.

Designed to cruise at very high altitudes, the U-2 has a very high aspect ratio wing of 90 ft. span and is powered by a special high-altitude version of the J57 turbojet. According to NASA its ceiling is 55,000 ft., its endurance is four hours and its top speed 500 m.p.h. But the latest version of the aircraft has pinion wing tanks which would extend its range and U.S. reports credit it with a ceiling above 60,000 ft.

According to Mr. Khrushchev, the U-2 was shot down by a surface-launched rocket at a height of about 66,000 ft. What type of "rocket" performed this feat is not disclosed but it could presumably be the Type M-2 which was first seen during the Moscow Parade in 1957.

Estimated launching weight of the M-2 is 1,500 lb., cut-off velocity Mach 2.5 and slant range 20 miles. Cruciform blade aerials on the nose of the sustainer suggest command guidance.

Perhaps the most surprising feature of the incident is that the U-2 was not completely destroyed and that the pilot escaped with his life. This tends to suggest that the intercepting missile was fitted with an inert warhead to ensure minimum damage and allow "secret" equipment in the aircraft to be recovered.

The escape of the pilot suggests that he stayed with the aircraft until it had fallen some distance. He came down by parachute without using his ejector seat, which according to the Russians would also have fired a charge to destroy the aircraft. It may be that the ejector-seat mechanism was damaged when the aircraft was hit.

Although the flight was made on May Day, when the Russian military was engaged on celebration parades, it is still interesting that a relatively slow aircraft should penetrate so far into Russia before interception. The attack by a ground-launched missile implies that the U-2 was above the reach of fighters.

Lecture Postponed

AS we go to press, we learn from the Royal Aeronautical Society that owing to illness Sir Thomas Sopwith will be unable to give his lecture to the Society's Historical Group on May 17. This lecture will now be planned for the autumn session.

TURBO-SKEETER.—With a derated Blackburn Turmo 601 shaft-turbine engine in place of the normal Gipsy Major, this Skeeter recently made its first flight at Eastleigh. It is to be used for the further development of the Louis Newmark auto-stabilizer for the Wasp.

U.S.A.F. Views on Deterrents

IT is unlikely that the R.A.F. will get the Skybolt air-launched missile before it goes into service with the U.S.A.F. This was stated in London last week by Gen. Thomas D. White, the U.S.A.F. chief of staff. The missile would probably become operational in 1964; its distribution to the U.S.A.F. and R.A.F. would be "on an equitable basis."

In the light of Britain's decision to abandon Blue Streak, Gen. White was asked whether the accuracy of Russian missiles had not made America's fixed-site ICBMs obsolete. He said that this was not so; fixed-base missiles relied for their deterrent value on dispersion and hardened sites. It was likely to take more than one nuclear warhead to eliminate a single missile site.

He said there was a need for both fixed-base and mobile missiles. The advantage of air-launched missiles was their flexibility. Skybolt would have "an enormous effect on anything that moves on the ground or on the sea"; the position of these targets could be given to the missile-launching aircraft by reconnaissance satellites. There would be no need for a standing patrol by Skybolt-armed aircraft, as they could take off within three or four minutes of a warning being given.

In future the U.S.A.F. balance between missiles and manned aircraft would change towards a greater proportion of missiles, but there was no intention of giving up manned bombers. Compared with the ICBM, they had the advantage of human intelligence. They could be recalled or change targets in flight. They could carry heavier nuclear loads; these and their greater accuracy made them more suitable than missiles for eliminating hardened targets. And finally the potential bomber threat meant that expensive enemy defences were necessary; if bombers were given up, the difficulties and cost of a defensive system were greatly reduced.

On the subject of Polaris, Gen. White said that he did not think it was "as invulnerable as many of its advocates claim." Discussing the Minuteman solid-fuel ICBM, he said that its development was on schedule and it should become operational in 1962 as planned. Continuation of the current ban on nuclear tests would not prevent Skybolt and Minuteman from becoming effective weapons. But, if in future warhead tests could not be made, "their growth potential would be inhibited."

A Belfast Appointment

WITH their current interest in large transports such as the Britannic, Short Brothers and Harland have created a new appointment within their aircraft design organization to cover the increasingly important subjects of mechanical and system problems. From Belfast comes the news that Mr. E. G. Collinson, B.Sc., A.F.R.Ae.S., has been appointed chief mechanical engineer of the company's aircraft division and will be concerned principally with these problems. Initially he will concentrate his interest on the Britannic.

Mr. E. G. Collinson who has been appointed chief mechanical engineer of Short's aircraft division.

Educated at Ulverston Grammar School and Manchester University, Mr. Collinson had been with British Messier, Ltd., since 1947—he was the company's chief technician for six years and in 1953 he was appointed chief designer. Before going to British Messier, Mr. Collinson was chief technician of the aviation division of the Dunlop Rim and Wheel Co.

More European Co-operation

RECENT reports of another Bristol Siddeley link with the Italian aviation industry were confirmed last week with the signing on May 1 of a licence agreement with the Piaggio company of Genoa. This is for the manufacture and sale in Italy of the Viper 11 turbojet which delivers a static thrust of 2,500 lb. and is the powerplant for the Macchi MB 326, the standard primary trainer for the Italian Air Force. It is, of course, for these aircraft that Piaggio will primarily manufacture the Viper 11, a first-hand account of the handling and general characteristics of the Viper-powered MB 326 was given in THE AEROPLANE AND ASTRONAUTICS on Jan. 8, 1960.

This is Bristol Siddeley's second Italian agreement: the Fiat company in Turin have for some time had a licence to manufacture Orpheus turbojets. These are in production at Turin for the Fiat G91 NATO strike fighter.

By all accounts the Viper has proved to be a most successful and versatile engine in the small-medium thrust category. In its 1,750-lb.s.t. Mk. 8 form it powers the R.A.F.'s Jet Provosts, later versions of which will have the Viper 11. In addition to its selection as the powerplant for the Macchi MB 326, the Viper 11 has been chosen for the Australian Jindivik 3 missile target drone.

The Viper is also produced in France where Marcel Dassault has a licence agreement with Bristol Siddeley for production and development of the engine. The current French version, known as the Farandole, has a static thrust of 3,000 lb.

Spaceflight at the Planetarium

FOR the past two years, the London Planetarium has been playing a useful rôle in introducing the public to the mysteries of astronomy. Now, in addition, they are preparing to conduct visitors on their first steps in astronautics.

The keen interest taken at the Planetarium in all matters of space-research is reflected in the many topical items which are regularly featured in their programmes. (A recent example was the inclusion of Transit I, the first navigational satellite, in a special navigational presentation only five hours after its launching.)

Now, for the first time, they are presenting a programme devoted entirely to space exploration. Visitors to the Planetarium at Whitsun and throughout the summer months will be given a vivid portrayal of contemporary progress with artificial satellites and space-probes.

Starting with Sputnik I and the "bleeps" that introduced the Space-Age, they will join Laika on her historic journey, reach still further with Pioneer I, and rocket into space with the Luniks which passed, hit and photographed the Moon. They will join Pioneer V as it travels into uncharted space and then, in graphic manner, stand with the scientists at Jodrell Bank as they establish contact with this latest ambassador, whose recorded voice will be heard sending back data from millions of miles in space.

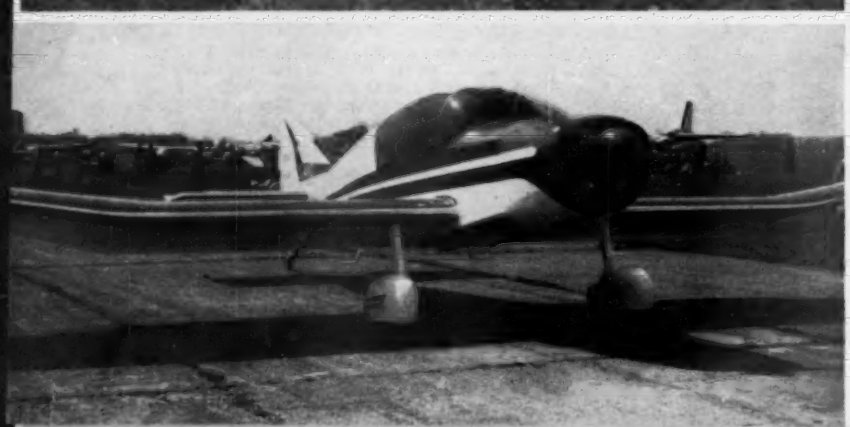
Orbits, shown in correct scale and perspective against the movements of the planets, will bring many of the problems of space navigation and communications sharply into focus. As new satellites and space-probes are launched, they too will be immediately incorporated in the programme.

A Successful Week-end

THIRD time lucky was an appropriate adage for the Shackleton sales week-end for light and executive aircraft, which for the first time in three years was blessed with fine weather at Kidlington throughout May 6-8. About 30 production types from Britain and overseas were displayed alongside a similar number of second-hand veterans, and attracted large crowds of visitors by road and air.

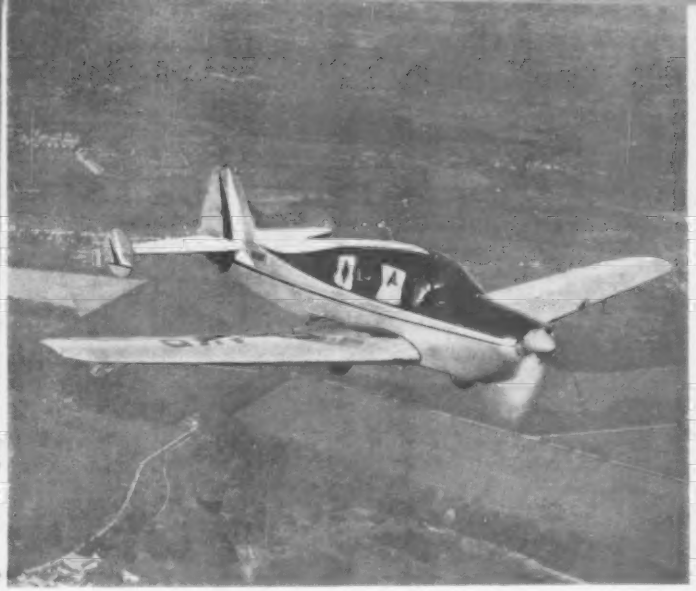
New arrivals making their first public appearance in this country included the Lycoming-powered J5V Autocar, G-APUW, the Irish-registered Bellanca 260, the five-seat Jodel D.140 Mousquetaire, G-AOVZ, the German RW.3 (under-) powered glider, a French-registered Cessna 310D, and the rakish Piper Aztec, G-APYX. Although received by Vigors Aviation only 24 hours before the opening of the sales week-end, the Aztec was demonstrated almost continually by Wg. Cdr. Tim Vigors, and its single-engine climbs-away immediately after take-off became a familiar, if slightly startling, spectacle.

The Piper "circus" of Cubs, Tri-Pacers, Comanche, Apache and Aztec also provided a highlight in the informal display for visiting executives on Friday afternoon, and Wg. Cdr. Murray's crazy-flying in one of the Cubs was a refreshing reminder of the more sporting capabilities of American aeroplanes. Aerobatics were also performed by Ed McCauley in the Bishop Tiger, and included a particularly spirited falling-leaf, as well as the more normal manœuvres, plus bunts and tight inverted turns.



Continental designs on display at Kidlington included the Rhein Flugzeugbau RW.3 A-2 Multoplane (above, left), which in nil-wind conditions required the entire length of Kidlington to become airborne; and the Jodel D.140 Mousquetaire (left), which was the first to reach this country. The Rollason-built Turbulent (above), with new spats and canopy, intrigued the U.S.A.F. more than somewhat.

Photographs copyright "The Aeroplane and Astronautics"



Above, an interesting new aeroplane at Kidlington was the Bellanca 260, which has a glass-fibre-covered wing of extraordinary cleanliness. Right, Auster's good-looking J.5V Autocar is virtually a prototype for the new D.6 series.

A Tipsy Nipper was flown to even more violent effect by Avions Fairey test pilot Mike Jacob, who rounded off almost every aerobatic in the book by crazy-flying low across the airfield. He spent much of his time apparently flying sideways, and finished by jerking the stick rapidly back and forth so that he progressed in a series of violent hiccoughs.

The displayed aircraft were backed by a small exhibition of associated equipment, and for the first time, the major finance companies, including Lombank and United Dominions Trust, were represented for possible credit facilities. Hants and Sussex Aviation, Ltd., displayed American and British engines for which it is authorized overhaul agent; and spares and maintenance organizations also included Nightscale Aviation and Personal Plane Services. Burndept, Ltd., displayed its lightweight five-channel VHF set, which is just about to be certificated. The A.B.A.C. had an information service for club flying.

Attention this year was perhaps even more directed towards the new aircraft types on show, which did a brisk trade in demonstration flying, but there were one or two notable veterans at Kidlington. They included the two remaining D.H. Dragonflies on the British Register, several Leopard Moths, including Ron Paine's beautifully restored G-ACLL, and a rather newer Aeronca Sedan, CF-FNM, from Canada.—J.E.F.

Above, Vigors Aviation's new Piper Aztec demonstrator spent almost as much time on one engine as it did on two during an intensive week-end's flying. It is a full five-seater, and is obviously a powerful challenger in the executive market.

Left, a Cessna 310C flies over some of the assembled aircraft at Kidlington, which include the Bishop Tiger Moth, the Rollason-built Turbulent and Rollason-modified Jackaroo, and the Lancashire Aircraft Co. Prospector.

Air Transport

U.S. Fares Decision

A SMALL general increase in passenger fares charged by the U.S. trunk airlines will follow the C.A.B. decision in the General Passenger Fare Investigation. This started almost four years ago and after being suspended while the airlines' claim for an interim increase was studied, was reactivated in November, 1957. The C.A.B. Examiner, Mr. Ralph L. Wiser, who had presided over the hearings, submitted his preliminary decision last year, and the C.A.B. has now issued a tentative ruling which confirms the examiner's decision.

The fare increases will be based on a formula which is designed to allow the 12 domestic trunk airlines a 10.5% overall rate of return on investment. Mr. Wiser had recommended that the average rate of return should be between 10% and 12% for any current five-year period. According to the A.T.A., the industry average for the five years up to 1958 was 8.61% and in 1959 it fell to 7.2%.

In 1957 the C.A.B. rejected a request from seven of the domestic airlines for a 6% fare increase because it then considered an 8% return on investment was adequate. At the time of this decision the suspended General Passenger Fare Investigation was reinstated and in the trial brief prepared in October, 1957, for the G.P.F.I. the C.A.B. staff recommended a return on investment of 8.9% for the "big four" domestic operators and 9.5% for the regional operators.

The suitability of the rate of return as an index of profitability was strongly contested by the airlines in the early stages of the G.P.F.I., the profit margin or operating ratio being the preferred industry yardsticks. On this basis the domestic operators earned 3.3% or 3.3 cents per dollar of revenue in 1959.

The C.A.B. has also established depreciation standards for fare-making purposes. Piston-engined aircraft will be depreciated over seven years and turbine-engined aircraft over 10 years, with a 15% residual value in both cases. Turbine engines will be depreciated to 15% over five years.

In the year ended Mar. 31, 1959, British European Airways achieved a profit margin of 4.7%, and the return on investment was of the order of 3.8%. The B.O.A.C. profit margin was about 1.4%, and the return on investment was a little over half of 1%, excluding associate company results.

Barbados to Washington

TALKS on the 1946 Anglo-American air services agreement were restarted in Washington on Apr. 28. The previous series, in Barbados, had continued between Feb. 24 and Mar. 17; judging from the limited nature of the information given in an official statement at the conclusion of these talks, very little progress had been made towards agreement in matters other, perhaps, than those of Caribbean route-right interest. The British delegation is again being led by Mrs. Alison Munro, Under Secretary, Aviation Overseas Policy Group, Ministry of Aviation.

According to preliminary reports from Washington the U.S. delegation is once more asking for Tokyo-Hong Kong traffic rights for Northwest Airlines and for further eastward extensions out of London for T.W.A. Northwest has U.S. approval for the Hong Kong extension, but the necessary British approval has still to be obtained. These are, presumably, the major negotiating weapons and in return the U.K. might be expected to ask for California—Sydney traffic rights, for various lesser rights in the Bermuda/Caribbean/Florida areas, and for frequency restrictions on P.A.A. and T.W.A. services between the U.K. and points in Europe. A Los Angeles-Sydney service via Honolulu is, however, to be among B.O.A.C.'s plans for next year, as an extension of the U.K.-U.S. West Coast Arctic service which will be operated by Boeing 707s.

Trying to Save Capital

LATEST development in the fight to save Capital Airlines from bankruptcy is a plea to Vickers from the company's Shareholders Association to delay foreclosure proceedings. The association represents a large proportion of the company's employees and was formed last August.

Captain C. Beatley, a Capital pilot and president of this association, is reported to have said that it believes it has "a logical plan that will be acceptable to the British interests that hold the notes." One suggestion involves the payment by the shareholders of $500,000 a month, some 10% of their salary, to help pay off the $34 million debt. A new shareholders' meeting is being called by the association, but cannot be held for about two months; this meeting will seek to depose the present board and elect a new management.

On May 6 Capital was granted a delay until May 27 for its appearance before a U.S. Federal Court in New York to answer Vickers' threat of foreclosure. The airline's second appeal to the C.A.B. for an immediate Federal subsidy was rejected at the end of April. The Board said that it would not act before formal hearings on the plea as a "serious question was presented whether the airline would be entitled ultimately to any subsidy whatsoever." Capital has been given until Jne. 5 by the Board to file full information on its subsidy claim (see our issue for Apr. 29, p. 505).

In another move on May 5, Capital asked C.A.B. for permission to increase fares by 4% plus $1 per ticket. The increase would apply on Jne. 4 if the C.A.B. raises no objection, and is being sought on the basis of the C.A.B.'s new formula for calculating fares (see opposite column).

Convair 880 Certificate

A FINAL airworthiness certificate was issued for the Convair 880 by the Federal Aviation Agency on May 1, the original target date laid down three years ago. The first service is to be operated on May 15 by Delta Air Lines, between New York, Atlanta, New Orleans and Houston. Deliveries to T.W.A. are to begin before the end of this month.

Four Convair 880s have been used in the test programme, and have completed more than 1,200 hours of flight test time. In addition, the first production 880, which was delivered to Delta in February, had completed by May 1 nearly 400 hours of crew familiarization and route flying.

As part of the F.A.A. functional and reliability trials which are necessary to obtain the C. of A., Convair undertook an airline operational flight test programme of 151 take-offs and landings in 154 flight hours. Such an intensive operation has not been completed by other jet transports but was considered to be necessary because of the short-to-medium haul services the Convair 880 will fly. The programme took the 880 over the whole of the U.S. and included a 28-hour period of icing trials in Alaska.

About half of the total flying time was on trips of less than

(*Continued on page 577*)

DUTCH DOUGLAS.—K.L.M. was the first airline to operate the Douglas DC-8 over the North Atlantic, starting on Apr. 16. The flagship of the fleet (seen here) is "Albert Plesman"; next week, on May 17, the third K.L.M. DC-8 will be named "Sir Frank Whittle" in a ceremony at London Airport.

EVEN BETTER THAN PROMISED

Before the first Vanguard goes into scheduled service, and little more than a year after the first flight tests, development has made possible dramatic increases in maximum operating weights. Details are given in the table below. These improvements have been achieved for an empty weight increase of only 600 lb, and allow a margin of 1,600 lb for future development, equipment changes or customers' special requirements.

VANGUARD PAYLOAD UP BY 8,000 lb

	Original specification	New specification	Increase
GROSS TAKE-OFF WEIGHT	141,000 lb	146,500 lb	**5,500 lb**
MAX. LANDING WEIGHT	121,000 lb	130,500 lb	**9,500 lb**
MAX. 'ZERO FUEL' WEIGHT	112,500 lb	122,500 lb	**10,000 lb**
MAX. PAYLOAD	29,000 lb	37,000 lb	**8,000 lb**

The Vanguard can now carry 139 economy-class passengers plus over 8,000 lb freight. Without intermediate refuelling, 100-passenger payloads can be carried over such important consecutive sectors as London–Frankfurt–Vienna–Prague.

Operators with profit in mind and air travel for all in view, will find the Vanguard is more attractive than ever.

VICKERS VANGUARD

FOUR ROLLS-ROYCE TYNE PROPELLER-TURBINE ENGINES

The airliner with the biggest profit potential ever offered to the operator

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

TGA AT656

C

LET'S MAKE IT CLEAR

Fairey Aviation Ltd., which has been sold to Westland Aircraft Ltd., was one of Fairey's subsidiary companies. There are ten others. Their interests range from nuclear power stations to aircraft hydraulics, from guided weapons to aerial survey and from machine tools to motor cruisers.

. . . . . .

ENGLAND

Fairey Engineering Ltd.

Nuclear reactor design—power reactor equipment for the new atomic power station being built at Trawsfynydd, North Wales, by Atomic Power Constructions Ltd., the nuclear consortium of which The Fairey Company Ltd. is a member.

Nuclear engineering—special purpose machines and equipment, aluminium and steel fabrications, finned fuel element cans and reactor components, for the United Kingdom Atomic Energy Authority and for the Civil Power Consortia.

Experimental nuclear equipment and research—for the U.K.A.E.A.

Control system engineering and electronics—nuclear control equipment and special instrumentation including nuclear magnetic resonance spectrometers and analogue computers.

Petroleum equipment—fabrications in aluminium, stainless steel and other metals.

Machine tools—three-dimensional electronically-controlled contour milling and other special purpose machines, the most advanced machine tools in Europe.

Guided weapons—research and development.

Pilotless target aircraft—the Jindivik (designed and built in Australia) for which Fairey Engineering holds the European sales rights and repair and maintenance contracts from the Ministry of Aviation.

Aircraft hydraulic power controls—for the world's leading aircraft including the Vickers-Armstrongs Scimitar, Fairey Rotodyne, Hawker Hunter, Avro-Canada CF-100 and English Electric Canberra PR.Mk.9.

Industrial hydraulics—for forging presses, simulators and process tools.

Plastics machinery—injection moulding conversions and pre-plasticisers.

Fairey Air Surveys Ltd.

Aerial survey of projects as far apart as London and the Kariba Dam, the Caribbean and Burma.

Fairey Marine Ltd.

Dinghies and speedboats, yachts and cruisers, launches and lifeboats—Europe's largest boatbuilders.

Aeroplastics Ltd.

Moulding, fabrication, design, and research, in every type of plastic material for every industry from shipping to electronics.

AUSTRALIA Fairey Aviation Company of Australasia Pty. Ltd.

CANADA The Fairey Aviation Company of Canada Ltd.
Aero Surveys Ltd.

BELGIUM Avions Fairey S.A.

RHODESIA Fairey Air Surveys of Rhodesia Ltd.

PAKISTAN Air Survey Company of Pakistan Ltd.

THE

FAIREY

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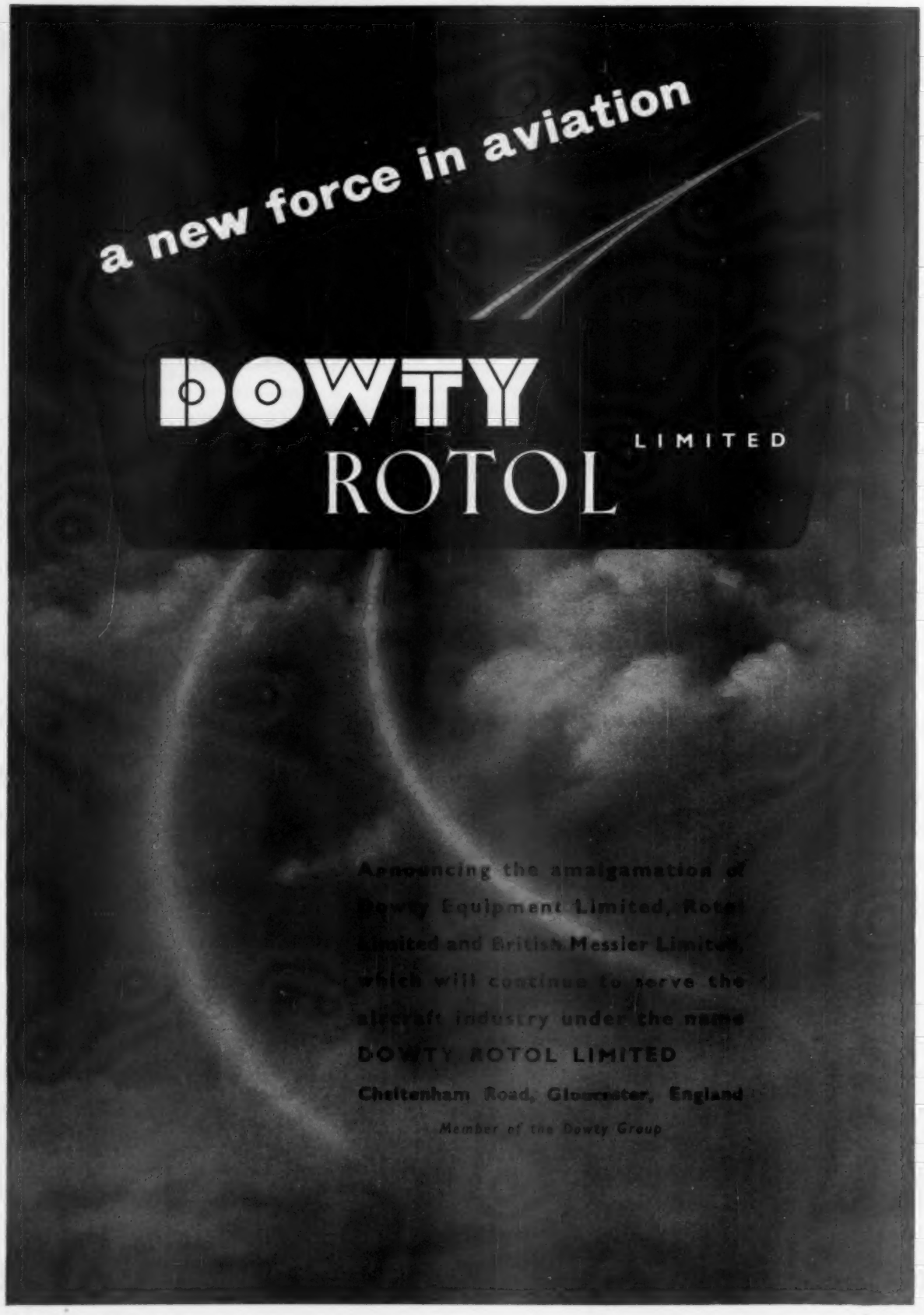
a new force in aviation
DOWTY
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LIMITED
Announcing the amalgamation of
Dowty Equipment Limited, Rotol
Limited and British Messier Limited,
which will continue to serve the
aircraft industry under the name
DOWTY ROTOL LIMITED
Cheltenham Road, Gloucester, England
A Member of the Dowty Group

Air Transport . . . .

(*Continued from page 576*)

150 miles, and a total of 20 cities was visited. To make the 880 independent of ground starters, an AiResearch turbo-starter was installed in the forward baggage hold and was used on numerous occasions. The aircraft carried a ground crew of eight and three flight crews; throughout the trial, it was self-supporting and no spares had to be supplied from the home base at San Diego.

IATA Technical

LAST week and this, the 13th annual Technical Conference of IATA has been taking place in Lucerne. Some 500 delegates have been present for all or part of the time, making it the largest IATA conference ever held; of this total, more than half were from member airlines in 25 countries and the remainder were representatives of air forces and aviation agencies of 10 governments; of ICAO and other international agencies; of research laboratories; of more than 60 aircraft, engine and instrument manufacturers; and of 11 oil companies.

Eight items on the agenda were discussed in open sessions last week, with participation by the non-airline representatives. The subjects covered in these discussions, all in relation to turbine transports, included Doppler radar navigation systems; ATC and upper airspace problems; cockpit instrumentation, design and layout; dispatch procedures; take-off techniques and flight planning; problems in the apron and maintenance areas; maintenance problems with new equipment; airborne recorders; and engineering and maintenance problems in aircraft pooling and interchange agreements.

Two other items were discussed by the airline representatives alone in two days of closed sessions. These covered flight crew training for jet transports, and minimum noise techniques. Special attention was also given by one committee to turbine fuel requirements and cleanliness standards. At the end of the Conference, the IATA Supersonic Group, which is made up of some members of the technical committee, met to prepare for a symposium on the subject at the 1961 Technical Conference, to be held in the U.S.A.

Among the industry papers presented at the Conference was one on the new Smiths Para-Visual Director (see page 579) and one by B.O.A.C. on the Marconi Doppler navigator. Another described in detail the Lockheed-Royston Midas flight recorder (see our issue for Apr. 29).

The Air-freight Business

DOUGLAS AIRCRAFT CO. now has contracts with four airlines to convert a total of 24 DC-7 series aircraft to all-freight configuration. These are in addition to the 10 DC-7Cs converted by Lockheed Aircraft Services for Pan American. Both DC-7B and DC-7C types are involved in the Douglas programmes, which will cost the operators a total of more than $6½ million.

American Airlines has increased its order from 10 to 15 DC-7Bs, and Pan American-Grace will have one DC-7B refitted; work on United Air Lines' order for six conversions is already proceeding. The first DC-7Cs to be converted by Douglas will be two for K.L.M., to be delivered in September, 1960, and January, 1961.

Basic modifications to both the DC-7B and the DC-7C are similar and involve the removal of all passenger facilities; the installation of large cargo doors; the replacement of the entire floor and floor-beam structure with heavier components; the removal of windows; and the installation of glassfibre-laminate lining inside the cabin. Douglas tells us, incidentally, that the DC-7F designation is entirely unofficial "but it probably will stick for want of another label." The company calls the conversion the Speedfreighter.

Eurofreight, Ltd., is a new name among U.K. freight shippers. The company has been formed by Mr. J. K. Ambler, a director of Atlas Express, to take over the Trukair service, and now offers also a Truksea service. In both cases, door-to-door service is provided between U.K. manufacturers and European retailers, the Channel crossing being either by Channel Air Bridge aircraft or by ship.

Alitalia is now represented on the Baltic Exchange by M. K. Kendall, Ltd., of 14 Eldon Street, London, E.C.2. Its two DC-6Bs available for charter will eventually be augmented by DC-7Cs and Viscounts.

Narrow-gauge Lights at New York

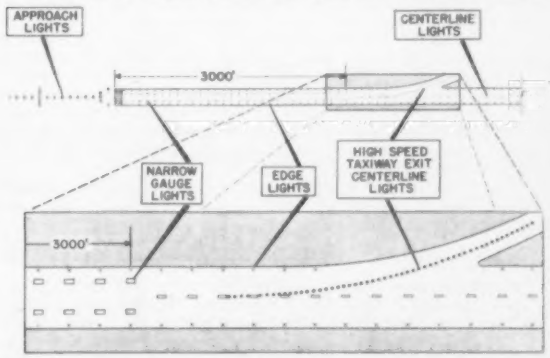
DESCRIBED in our issue for Dec. 18, 1959, the new 4R:22L runway at New York International Airport came into use for instrument landings in February. For four months previously it had been open for use in VMC only, while instrument-landing aids were being installed. The latter are now complete at the south-west end, and a duplicate installation at the north-east end will become operational in the near future.

It is intended that the 8,400 ft. runway will then be used exclusively for landings in IMC, while the older parallel 4L:22R runway will have its instrument-landing facilities withdrawn and will be used exclusively for take-offs in IMC. The P.N.Y.A. recently confirmed plans, already reported in THE AEROPLANE AND ASTRONAUTICS, to extend the runway by 600 ft. to the north and by 3,550 ft. to the south (into Jamaica Bay) to provide a total length of 12,000 ft.

Newest feature of the new 4R:22L runway is the use of narrow-gauge lighting, of the type already in use at U.S.A.F. bases but not previously installed at a civil airport. Two rows of lights, 60 ft. apart, extend for 3,000 ft. down each end of the runway, with a single centreline of lights continuing on to the ends of the runway. The 100-watt lamps are in flush installations and are controllable in brilliance from the tower; over the first 1,000 ft., two lamps are used in each fixture to give greater vertical light distribution.

The new runway has four high-speed taxi exits designed for speeds up to 60 knots. Each is 75 ft. wide, has a 1,800 ft. radius and leaves the runway at a 30° angle. Centreline lighting extends for 1,000 ft. down each taxiway.

High-intensity centreline approach lights extend for 3,000 ft. from each end of the runway and include condenser discharge flashing lights which flash in rapid sequence to provide the effect of a moving finger of light pointing toward the runway.



The diagram (above) and photograph illustrate the distinctive features of narrow-gauge runway lighting, now in use on the new instrument runway at New York International.

Certificating B.O.A.C.'s 707s

THE changes to the Boeing 707s which are now being delivered to B.O.A.C. have been the subject of a good deal of speculation. A certain amount of factual information has been issued by the manufacturers, but the time has now come to attempt to go rather more thoroughly into the factors which have led to these modifications.

First of all, it should be stressed that the 707, in all its variants, has shown itself to be a remarkably sound transport aeroplane. It is reliable and operationally attractive and, on the whole, it is liked by its crews. But, as incidents and accidents during crew training have shown, it has certain disconcerting characteristics. Obviously, as events turned out, neither Boeing nor the Air Registration Board can have been very happy about these characteristics.

The difficulty seems to have been that of deciding, in the face of the evidence of an accident-free service record, on the necessity, as opposed to the desirability, of fundamental improvements. The good record—apart from that on training flights—could be at least partly explained by the exceptional reliability of turbojet engines, in that 707 crews have rarely been faced in service with the situations which are simulated during training. But engine reliability cannot always be guaranteed and the good record could very easily be broken by a succession of failures coupled with the effects of the known handling peculiarities. Adequate crew training has remained, too, something of a problem for the airlines.

It was this crew-training situation which was probably the overriding factor in the decision of the A.R.B. to press for modifications, and it was the Board's firm stand, vigorous criticism and positive efforts which have forced a decision. The practical results have been that Boeing have grasped the nettle rather earlier than they might otherwise have done; that all future production versions of the 707 Intercontinental will have the revised rudder-control system and increased fin area; and that modification kits are being offered to operators for their existing aircraft.

What was the nature of these handling difficulties? In simplest terms they appear to have been the result of a combination of limited directional control (as demonstrated by at least one training accident), inadequate directional trim and excessively high rudder loads in some flight conditions. Combined with the accepted characteristics of a heavily loaded swept-wing aeroplane, these control deficiencies were unacceptable to the A.R.B. In the Board's view, something had to be done to improve them, and Boeing's own modifications were, in fact, being developed and tested against the moment when action could be taken.

The rudder peculiarities led to various difficulties in control co-ordination such as that required during recovery from a build-up of Dutch roll and during various asymmetric-power situations and have been increased by factors such as the variation in foot loads through different rudder angles, the inability to trim out the loads at bigger angles, and, it is believed, a certain lag in rudder movement following any vigorous corrective action in emergency. The high residual (i.e. untrimmable) loads have quite naturally led pilots to apply assisting aileron/spoiler action, and this, in turn, could lead the aircraft into unsatisfactory and possibly hazardous situations. The lag could lose vital corrective time after engine failure.

The rudder-control system and geometry of the existing 707 is very complicated, but some understanding of this is essential in explanation. Earlier 707-120s had aerodynamic control only, but later variants have had power-boost assistance for bigger angles of rudder movement. Thus, as offered for A.R.B. certification, the 707-436 had a rudder system which involved manual (aerodynamic) operation by servo tab up to about 10° of movement either way; the tab also carried the trimming mechanism. Between 10° and 15° the power booster began to take over and the tab ceased to act as a medium of balance. At angles over 15° there was complete power boost with the tab operating in the anti-balance sense (to improve rudder effectiveness) and with no means of trimming. Q-feel was applicable through the boosted range of movement and for structural safety reasons the system in earlier and later variants was arranged to "give way" at foot loads higher than 180 lb.

The additional fin area on B.O.A.C.'s 707s can be seen in this and the air-to-air photograph at the top of the page. The original and revised tails were compared in two pictures in last week's issue, page 550.

So there was, in brief, a rudder system which was operated in three different ways according to the amount of its deflection, with no means of trim-relief at larger angles, with a positive restriction in maximum deflection in heavy load conditions, and with a tendency for an operational lag during any rapid and heavy rudder-control application.

The situation was understood by pilots and proper corrective action was a matter of training and practice. But, apart

(Continued on page 579)

Handing over at Seattle. In front of the first 707 for B.O.A.C. are, from left to right, Bill Carlyon and Tom Spalding (Boeing Transport Division contract administration); Ivor Lusty (B.O.A.C. resident representative); Serge Gorney (Transport Division product co-ordinator); Charles Abell (B.O.A.C. chief engineer); J. L. Uncles (707 project engineer); Capt. H. J. "Dexter" Field (B.O.A.C. chief technical pilot); and Tom Gillan (B.O.A.C. inspector).

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Air Transport . . . .

(*Continued from page 578*)

altogether from any criticism of general handling, the characteristics of the system were such that, with the higher take-off power available from the Conway and later J75 marks, the unmodified 707 could only be certificated to A.R.B. standards by raising the minimum control speeds and thus unsatisfactorily restricting its take-off and landing performance.

The changes which Boeing incorporated have, at the same time, improved the general characteristics and permitted a reduction in minimum control speeds—with consequently better runway performance.

These changes have involved—in addition to the considerable increase in fin area which can be seen in the picture on the previous page—a rationalization of the entire rudder-control system. The rudder is now fully powered through its whole range of movement. The power supply and appropriate systems are duplicated for obvious safety reasons—and, more important, in order to provide maximum rudder deflection, without delay, in emergency conditions. The pressure is supplied at 3,000 p.s.i. for low-speed flight and 1,000 p.s.i. for high-speed flight, thus providing two different power "ratios" with the changeover controlled by a q-operated switch. The trimming system now operates, through the q-pot mechanism, over the whole range of rudder movement.

There has been no duplication in the yaw damper system, which will, as before, normally be inoperative during the take-off/climb and approach/landing stages of flight.

The ventral section of additional fin area also acts as a "bumper" or take-off angle "restricter." It is not designed to be "bumped" in the ordinary course of events, but will take normal loads and rubbing. Tests last year at Edwards Air Force Base, using temporary fuselage-skin protection in the form of a long metal strip supported on wooden blocks, showed that the 707-420 series will, in fact, get off at an unrestricted angle, but only after running for an unreasonable distance.

The tests showed that, at very big unrestricted ground angles and apart from the expected drag increase, the lift decreased more than had been anticipated by the aerodynamicists. The new ventral fin will prevent the ground angle from being increased beyond that at which a safe take-off will still be possible within the normal field length.—H.A.T.

A New Approach to Attitude Display

DETAILS of a radical concept in the field of flight director instrumentation were contained in a paper presented at the 13th IATA Annual Technical Conference which concluded yesterday in Lucerne. Described by two members of Smiths Aviation Division—Mr. A. M. A. Majendie, director of operational requirements and Mr. K. Fearnside, director of research and engineering—this display technique is known as Smiths Para-Visual Director (P.V.D.).

Designed to present flight-control information to the pilot without distracting his attention from other tasks, or preventing him from looking about the cockpit or out of the windscreen, the P.V.D. depends on one main feature. This is to provide visual information outside the pilot's fixed line of sight, but still within his general field of view.

Tests suggested by one of the authors of the paper were undertaken by Mr. E. S. Calvert, of the R.A.E., Farnborough, just over 10 years ago and demonstrated that, when landing, significant visual clues were received by the pilot from the changing pattern of the runway environment. It was also shown by photographic methods that the pilot did not use a series of individual visual checks to assess these clues, but stared steadily ahead, allowing the changing pattern to stream across his field of view.

These results and the principle of the visual method of assisting human balance are employed in the new Smiths flight director. This principle shows that if a human subject sways forward when standing still, nearby objects on either side to the left and right appear to move backwards; and balance is preserved by a correction pitching the body backwards—in the same direction as the apparent movement.

The basic flight-deck installation consists of three display units sited around each pilot, one in front of him and the other two disposed symmetrically on either side, all three being sensibly in a horizontal plane and below eye level. Each display unit comprises a servo-driven cylinder, with a black and white helix inscribed on its surface. Rotation of the cylinder gives the illusion of longitudinal motion from the pattern of the helix.

In operation, the display in front of the pilot is used to provide demands of bank angle, and the two on either side, which are slaved together, for demands of pitch. If the lateral display shows motion to the right the pilot banks to the right until the display is once more at rest. Similarly, if the pitch displays run forward, the pilot moves the control column forward, in compliance with nose-down pitch demands, until the displays are again at rest.

Each display unit is fitted with integral lighting and a spring-loaded shutter which is held open under power-on conditions. This shutter is allowed to close when malfunction occurs, thus providing an obvious indication of this condition.

The actual relationship between the display speed and attitude is non-linear, and a rate-limiting signal would be employed in any fully developed system. Subject to this, Smiths state that it can be used for all phases of flight when a conventional flight director would normally be employed.

A fair amount of experimental flight experience has been obtained by the company to date, most of it in Varsity aircraft fitted with the B.L.E.U. automatic landing system operating at R.A.E. Bedford. A P.V.D. installation is in the Smiths Aviation Division Dove which was flown to Lucerne for the Conference. Experimental units have also been supplied for test purposes as part of the instrument display for helicopters.

A typical display unit of a Smiths Para-Visual Director installation. The black and white helix is inscribed on the surface of a servo-driven cylinder.

Test reports state that, under normal manual instrument approach conditions, it has been found possible to fly an accurate ILS approach with the pilot free to look around over a surprisingly wide angle. Complete approaches have been flown with the pilot deliberately looking out of the cockpit at an angle of 45° from dead ahead, yet close-coupled instrument flight has been maintained with the display system.

In a B.L.E.U. equipped Varsity the P.V.D. has been employed as a means of providing instrumental guidance during landing flare-out. The installation was arranged so that signals from the automatic landing coupling unit could be fed either to the autopilot or to the P.V.D., or both. Manual instrument control of the flare-out has been achieved using P.V.D., when azimuth control in the final stages has generally been by direct visual means, so that flight control has been on instruments in pitch and visually in roll and yaw.

A number of completely blind touch-downs have been undertaken using the bank P.V.D. display for azimuth guidance. But, owing to the problem of kicking-off drift in the final stage, this technique is not acceptable under cross-wind conditions.

The left-hand seat of the Smiths Aviation Division Dove fitted with the Para-Visual Director. The installation comprises three display units which provide pitch and azimuth information.

Trends in Laminar Flow Research

by Dr. G. V. Lachmann, Dr.Ing., F.R.Ae.S.*

THE Boundary Layer Research Meeting, sponsored by the Fluid Dynamics Panel of AGARD, took place in London from Apr. 25 to 29, 1960. The organization was delegated to Dr. W. P. Jones, of the N.P.L., and secretarial matters were in the hands of F.D.P. Executive, Col. H. A. Ellison. It was attended by some 120 representatives from NATO countries. The meetings were held at the Main Conference Suite in Whitehall Gardens.

The sessions were opened by Mr. E. T. Jones, U.K., Vice-chairman of AGARD; and Prof. Schlichting in an introductory paper subsequently reviewed briefly the progress that has been made in the field of boundary-layer research in recent years. His paper, entitled "A background to the problems of boundary-layer research," is an outstanding example of brevity, conciseness and clarity of presentation in the best tradition of the Prandtl school.

Papers presented at the meeting fitted into the following framework: Effects of roughness on boundary-layer transition; boundary-layer control; stability of shear layers; mechanism of transition and boundary-layer stability; three-dimensional boundary layers; turbulent boundary layers, and heat transfer.

The field of boundary-layer research has become so vast and is still expanding so rapidly that one single mind can hardly grasp it in its entirety. At the end of the meeting one felt like having walked through a vast art exhibition encompassing classicism, French impressionists, expressionists, and the "avant garde," formed in the case of boundary-layer research by those for whom life begins at Mach 5. Some of the papers of highest calibre and greatest fundamental importance dealt with the mechanism of transition and boundary-layer stability, e.g., the papers by Kovasznay (U.S.) on the "Mechanism of Transition"; Criminale (U.S.) on "Three-dimensional Instability"; Bradshaw and Stuart (U.K.) "Flow Stability in the Presence of Finite Initial Disturbance"; L. Lees and E. Reshotko (U.S.) "Stability of Supersonic and Hypersonic Laminar Boundary Layers."

Space does not permit a review of all fields of boundary-layer research. Of particular interest to the aircraft designer were the papers by E. J. Richards and M. K. Bull (U.K.) "Pressure Spectra and Space-time Correlations in the Boundary Layer"

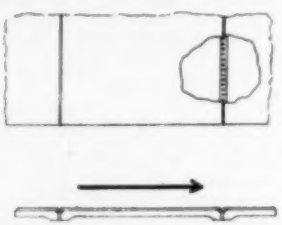


Fig. 1. Design of slitted suction surface.

and that of G. M. Lilley and T. H. Hodgson (U.K.) on "Surface Pressure Fluctuations in Turbulent Boundary Layers." Here, the subject of boundary-layer control for low drag and high lift will be reviewed in greater detail.

Boundary-layer Control for Low Drag

An impromptu lecture by Dr. W. Pfenninger (U.S.) entitled "Recent Results in the Field of Low-drag Boundary-layer Suction at High Reynolds Numbers" was a welcome addition to the programme. For about 10 years Dr. Pfenninger has been the leader of a very active team at Northrop engaged on theoretical and practical research of boundary-layer control for low drag. This work, sponsored in the past by the Wright Field Development Center, was highly classified and, therefore, known only to a relatively small circle. A recent declassification of a good deal of his work gave him an opportunity to report to a wider audience on the most important experimental and theoretical results which he has obtained.

In low-drag boundary-layer experiments in flight on the upper surface of a glove fitted to a F-94 aircraft, suction was applied through a large number of fine slits. Fig. 1 shows schematically the type of suction surface used.

Air sucked from the lower strata of the boundary layer passes first through a series of narrow slits which are cut into the thin outer skin which is bonded to the thicker inner structural skin. Small grooves which are located underneath the slits are milled into this skin, and throttling holes connect the grooves with the suction ducts underneath.

This design of the suction surface makes possible an efficient and practical suction method on wings and was used with great success on the F-94 glove after preliminary wind-tunnel tests at NACA and also at Northrop had given very promising results. At Northrop a specially designed tubular tunnel was used where large Reynolds numbers could be obtained and adverse pressure gradients simulated.

Full-chord laminar flow, coupled with very low profile drag was obtained on the F-94 panel up to the test limit of the aircraft at a chord Reynolds number of $Rc = 36.4 \times 10^6$ (Fig. 2). This is equivalent to a unit Reynolds number of 4.85×10^6 per ft. or to the conditions obtaining on a wing of 35.7 ft. chord operating at a Mach number of 0.85 at 50,000 ft. The extremely high unit Reynolds number obtained signifies the excellent surface conditions of the model. In flight at $M = 0.85$ at 50,000 ft. the unit Reynolds number is only 1.02×10^6 hence surface excrescences can be almost five times greater.)

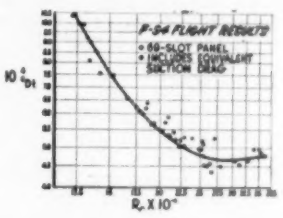


Fig. 2. Profile drag coefficients (including pump drag) measured in flight on the F-94.

A minimum profile drag of $C_{D_0} = 0.00045$ (including the equivalent pump drag) was measured for the sucked upper surface of the glove of the F-94 at a Mach number of 0.65. This would correspond to approximately $C_{D_0} = 0.0008$ with both surfaces sucked and projected area as reference surface.

Full-chord laminar flow was constantly maintained in horizontal flight, climb, descent, banked turns (up to 60° bank angle) and in moderately gusty weather. During a flight from Fort Muroc, in California, to Dayton, full-chord laminar flow was maintained throughout the flight. Rain caused transition; however, full-chord laminar flow was re-established after passing through the rain cloud.

One hundred per cent. laminar flow could also be maintained with increased speed until a local Mach number of 1.08 was exceeded. Paper covers over the leading-edge were used to protect the nose of the glove during the take-off and climb but it was found that fly specks on the leading-edge only caused transition to turbulent flow when the flight altitude was below 20,000 ft. At altitudes greater than 20,000 ft. fly specks did not usually cause transition.

In contrast to straight wings with laminar flow stabilized by suction the characteristics of laminarized swept wings at high Reynolds numbers are strongly influenced by the cross-flow in the boundary. Cross-flow is defined as a component of flow within the boundary layer which is normal to the potential flow (or outer) streamline. This cross-flow results from spanwise pressure gradients which exist on a swept wing.

This phenomenon of the destabilizing effect of cross-flow on a laminar boundary layer at sufficiently large Reynolds numbers was discovered by Gray at the R.A.E. in 1952 and was soon afterwards theoretically interpreted, at least for the nose of the section, by Owen and Randall, and others. Raetz, of the Northrop Group, calculated the exact development of the laminar boundary layer on swept wings with suction.

Dr. Byron Brown, of the Northrop Group, solved the disturbance equations of the boundary-layer cross-flow derived by Dr. Stuart, of the N.P.L., by direct integration. Fig. 3 shows two cross-flow profiles for flow at the leading- and the trailing-edges of a typical swept wing laminarized by suction.

Fig. 4 shows the corresponding curves for the cross-stability limit RNs (in British terminology the symbol χ is generally used). This critical Reynolds number is defined as the product of maximum cross-flow velocity and the thickness of the boundary layer, divided by kinematic viscosity. Raetz later obtained practically identical solutions to those of Brown on the basis of a different method by transforming the boundary-layer distribution equation into an integral equation.

* Director, Scientific Research, Handley Page, Ltd.

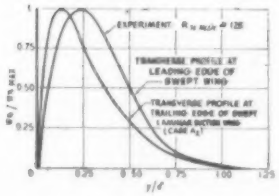


Fig. 3. Cross-flow profiles at leading- and trailing-edge of a swept wing.

These theoretical investigations led to the conclusion that full-chord laminar flow should be feasible on swept wings laminarized by suction with somewhat increased suction quantities compared with those necessary on an equivalent laminarized straight wing. In view of these conclusions, the Northrop Group undertook experiments in the 5-ft. by 7-ft. low-turbulence wind-tunnel of Michigan University with a 30° swept wing of 12% thickness/chord ratio having a symmetrical laminar profile, with the boundary layer stabilized by suction. The chord of this model was 7 ft.

The same model was subsequently tested in the 12-ft. Ames low-turbulence tunnel of NASA. Both series of wind-tunnel tests fully confirmed theoretical expectations. In the NASA Ames tunnel full-chord laminar flow was maintained on this model by means of suction through approximately 90 slits (located from 1% to 96% chord) up to chord Reynolds numbers of 29×10^6 at $\alpha = 0°$ and $\pm 1°$.

Fig. 5 shows the variation of profile drag for one surface (including the equivalent pump drag). The value of C_{D0} min. for both surfaces was 0.00096 at a chord Reynolds number of 28×10^6.

These very favourable results (corresponding to a unit Reynolds number of 4×10^6 per ft. or to a wing chord of 27.5 ft. at $M = 0.85$ when flying at a height of 50,000 ft.) are chiefly due to the very low turbulence levels in the Ames tunnel with pressure at 5 atmospheres. The drag rise which occurred at the highest Reynolds numbers was attributed to acoustic disturbances.

The author of the paper on approximate methods of solving the laminar boundary-layer equations for wings with regions of cross-flow (A. W. Lindfield) is a member of the Handley Page Research Department. Together with his former colleagues, H. and P. Pinsent, he has worked for several years on the development of suitable methods for calculating the characteristics of laminar boundary layers on swept wings and tapered wings which are stabilized by suction. This work was stimulated by, and benefited greatly from, the work of the American group.

Although an entirely independent and different approach was made, the agreement between the results obtained by the British and those of the American group, when starting from identical initial assumptions, was remarkably close.

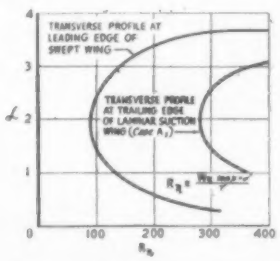


Fig. 4. Stability diagrams for cross-flow profiles at the leading- and trailing-edge of a swept wing.

$$\alpha = \frac{2\pi}{\lambda} \text{ (where } \lambda = \text{wave length of unstable disturbance).}$$

$$R_\eta = X = \frac{\text{max. cross-flow velocity} \times \text{boundary-layer thickness}}{\text{kinematic viscosity}}$$

Lindfield first describes a general integral method of solution for two-dimensional boundary layers to illustrate the underlying principles involved in solving the three-dimensional boundary layers. He makes special reference to Head's two-parameter method for solving the two-dimensional boundary-layer equations and then shows its application toward the solution of the three-dimensional equations. The three-dimensional equations are then treated in curvilinear co-ordinates and a general equation is obtained. First, the equations are written in streamline co-ordinates.

The step-by-step method used to solve these equations is described, first solving the streamwise equations and then the cross-flow equations. Next, a co-ordinate system particularly adapted to swept, tapered wings of constant section is introduced and the equations written accordingly. A short description is given of the application of these equations to predict the suction distribution required to stabilize the cross-flow on a swept tapered wing, imposing a stability criterion derived from the work of Dr. Byron Brown, of the Pfenninger group.

Finally, brief mention is made of applications of these methods to compressible boundary layers on swept, untapered infinite wings under the assumption of unit Prandtl number and viscosity proportional to absolute temperature.

For the untapered, swept infinite wing, the effects of heat transfer may be directly considered, and easily performed calculations show the favourable effects to be obtained by wall cooling.

Both the lecture by Dr. Pfenninger and the paper by Lindfield are not only closely interrelated, but they also have a certain general and historical significance. After the discovery of cross-flow instability by Gray, and after Owen and Randall had indicated the critical Reynolds number for cross-flow at the leading-edge, a very premature interpretation of this criterion led to the conclusion that excessive suction would be required to stabilize full-chord laminar flow on a swept wing.

Thus, further research on B.L.C., either in the theoretical or experimental field, was stopped at R.A.E. In fact, interest in laminar flow was buried with almost indecent haste which reflected strongly on Ministerial policy.

Thanks to the fine theoretical initiative of the American group under Dr. Pfenninger, it became apparent that, whilst Owen's criterion was correct for conditions at the leading-edge, a shape parameter for the cross-flow profile had been overlooked. This, when applied to the region of the flow in the adverse pressure gradient, made things much easier, and the increase of suction intensity much less severe than was predicted by applying Owen's criterion and treating it as having a unique critical value. This shape parameter was found to depend decisively on the second derivative of the velocities in the boundary layer near the surface (see Fig. 3 of Dr. Pfenninger's paper).

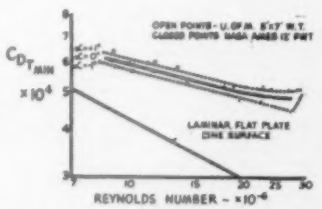

OPEN POINTS - U.C.L.A. 5'x7' W.T.
CLOSED POINTS NASA AMES 12' PWT
$C_{D_{T_{MIN}}}$
$\times 10^4$
LAMINAR FLAT PLATE ONE SURFACE
REYNOLDS NUMBER - $\times 10^{-6}$

Fig. 5. Min. profile drag coefficients of 30° swept laminar suction model. One surface.

Both in England and in the U.S.A. the torch was carried on by two industrial research groups and one University group at Cambridge, under Dr. Head, in the face of doubts and general indifference of some Governmental research Establishments.

It is hoped that the splendid experimental results obtained in the U.S.A. by Dr. Pfenninger on sucked swept wings at very high Reynolds numbers will dispel mental reservations still held in certain British circles regarding the applicability of suction to swept wings.

Boundary Layer Control to Prevent Separation

In "Calculation of the Turbulent Boundary Layer with Continuously Distributed Suction," by W. Pechau (Germany), the theoretical method is based on an approximate solution of the momentum—and energy-integral equations of the boundary layer. Pechau introduces the simple assumption:

$$\frac{\tau_0}{\rho U^2} = \frac{0.013}{R_\theta^{\frac{1}{4}}}$$

and in addition he puts $H \approx$ constant. τ_0 = wall shear stress; R_θ = Reynolds number based on momentum thickness.

The method is applicable to arbitrary continuous distribution of both potential and suction velocity. The assumption for the shear stress at the wall and the turbulent dissipation are taken from the theory of the turbulent layer without suction in a slightly modified form by introducing a not yet specified function of the suction velocity. The calculation yields a momentum thickness and a shape factor which is regarded as a criterion for the point of separation.

It is demonstrated by a numerical example that in order to avoid separation on the upper surface of an aerofoil it is more economical (so far as suction quantity is concerned) to concentrate suction on a short region near the pressure minimum than to extenu it over a larger area.* A small aeroplane with suction based on this principle is now being tested in Germany.

* In contrast to the method by Raspet and Cornish.

A Versatile Target

Details of the latest variant of t and recoverable target produced nautical Company for the U.S.A.

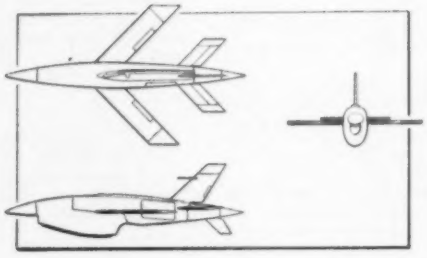
A NEW version of the Ryan Firebee, the subsonic target drone, has recently made its appearance in the United States. This is the Q-2C which in trials at Hollomann Air Force Base, New Mexico, has attained an altitude of 59,800 ft., a speed of Mach 0.96, and a duration under power above 50,000 ft. of 77½ minutes.

The original Firebee first appeared in 1951 and for many years has been a reliable " workhorse " for the test and evaluation of American surface-to-air and air-to-air guided missiles. For example, the Q-2A was the sole air target used in the U.S.A.F. World-Wide Weapons Meets of 1958 and 1959. It has also been used extensively for the training of ground crews and pilots.

Designed to simulate the performance of piloted jet aircraft under remote control, Firebee is about half the size of a modern fighter. The latest variant is powered by a single Continental J69-T-29 turbojet having a sea-level static thrust of 1,700 lb. The engine, mounted below the front fuselage, exhausts beneath the tail. Wings and tailplane, both swept at 45°, are of constant chord. A vertical stabilizer is fitted and there is also a small under-fin.

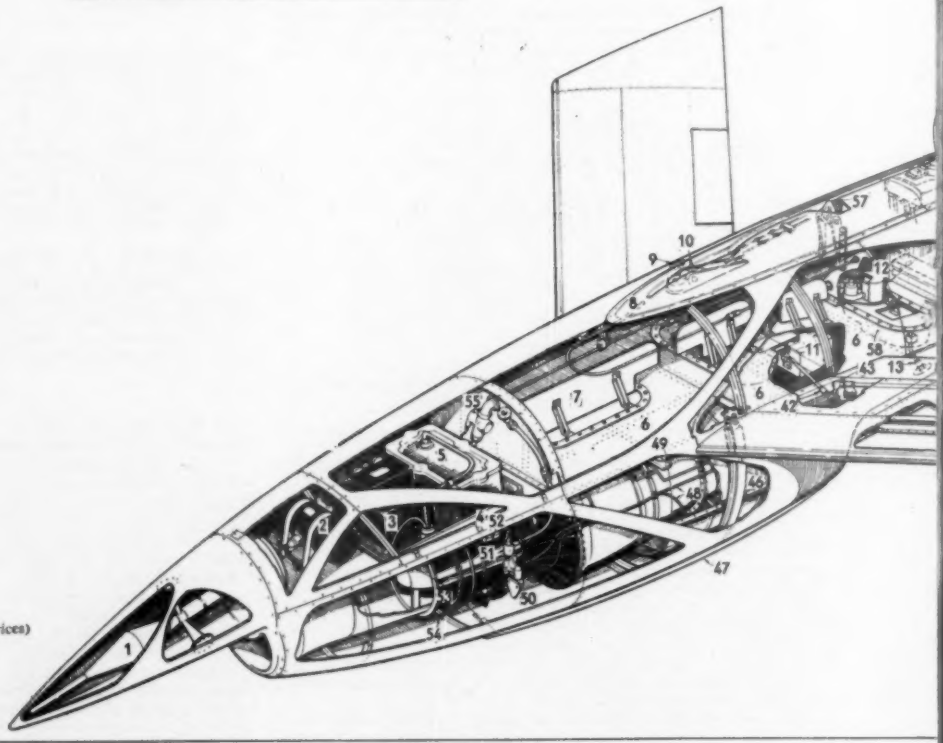
Firebee can be air-launched from the bomb-bay or from racks beneath the wings of a parent aircraft (two can be carried by a Douglas GB-26). It can also be launched from the ground or ships with the assistance of JATO units. In flight, the remote controller flies the target drone from a control box which embodies a control column and various switches governing such things as engine speed, in conjunction with a radio transmitter.

Recovery of the target is achieved by means of a two-stage parachute system which serves to decelerate the drone from its near-sonic operating speed and lower it gently to the ground.



RYAN Q-2C FIREBEE

One 1,700 lb.s.t. Continental J96 tu

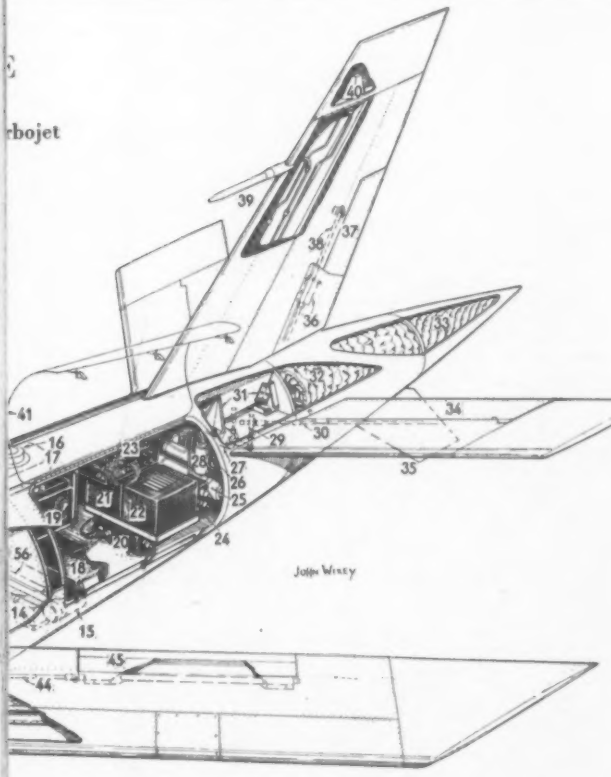


KEY

1. Scoring antenna
2. Scoring equipment
3. Power control box
4. Nacelle tray
5. Battery
6. Fuel tanks
7. Baffle plates
8. Fuel vent
9. Filler cap
10. Pick-up latch
11. Aileron servo
12. Fuel booster pump
13. Fuel drain line
14. Recovery relay box
15. Voltage regulator
16. Main external connection
17. Distribution box
18. Inverter
19. Flight control box
20. " Demultiplexer "
21. Audio recorder
22. Radio receiver
23. Telemetering unit
24. Altitude/airspeed indicator
25. S-Band beacon
26. Sequential timer
27. Elevator servo
28. Radar decoder
29. Elevator linkage
30. Elevator torque tube
31. Stabilizer attachment points
32. 81.6 ft. dia. main parachute
33. 6-ft. dia. drag parachute
34. Elevator
35. Under stabilizer
36. Trim rudder actuator
37. Rudder
38. Rudder torque tube
39. Pitot tube
40. Radio control antenna
41. Equipment door
42. Linkage (aileron)
43. Bellcrank (aileron)
44. Torque tube (aileron)
45. Aileron
46. Tailpipe shroud
47. Skid
48. Wiring harness
49. Aft engine mount
50. Forward engine mount
51. Fuel filter
52. Tachometer
53. J69-T-29 turbojet
54. Oil-system hose
55. Solenoid valve (fuel system)
56. Interconnecting box (special devices)
57. Lift shackle
58. Sump (fuel tank)

he remote-controlled by the Ryan Aero-F.

A Douglas B-26 goes aloft with two Q-2C Firebees on under-wing pylons.



The recovery system is designed to operate automatically in the event of a "hit," loss of radio contact, engine failure, or a deliberate command signal from the operator. Immediately Firebee makes contact with the ground, the parachute disengages to prevent incidental damage caused by the drone being dragged along by surface winds. At the time of parachute deployment, a pick-up latch erects on the top of the fuselage to permit the drone to be hooked up on a cable beneath a helicopter and transported back to base for servicing and re-use.

The earlier Firebee Q-2A, powered by a J69-T-19 turbojet of about 1,000 lb.s.t., had an all-up weight of 1,800 lb.; its fuselage length was 18 ft. and the wing-span, 12 ft. Development of the Q-2C, which is larger and heavier (see the accompanying table), arose from the need to fulfil more exacting rôles in missile evaluation and training.

One of the new features is "active" radar augmentation, taking the form of radar beacons, travelling-wave tubes and other echo enhancers. These increase the reflective cross-section giving the drone the "appearance" of a much larger aircraft. Infra-red flares are also incorporated as an aid to the evaluation of heat-seeking missiles, such as the Philco Sidewinder. Other refinements are an electronic "miss-distance" scoring device and a visual identification system employing a smoke generator.

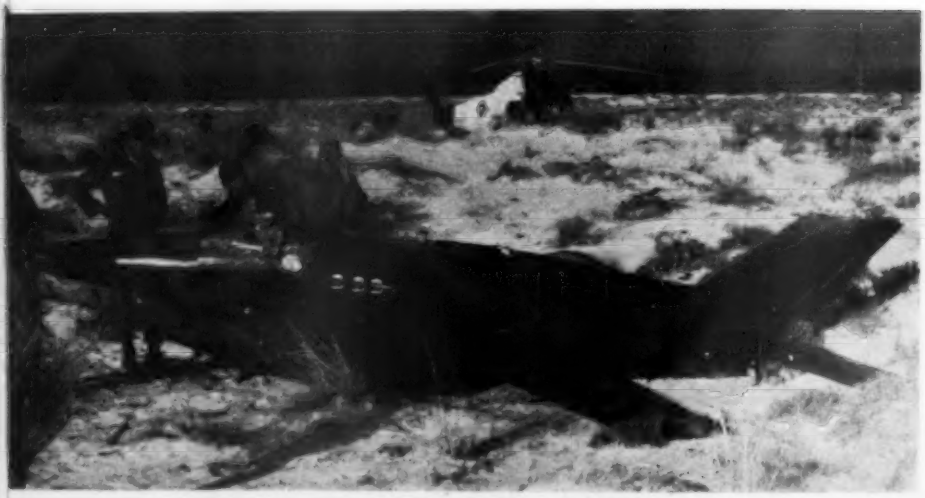
An automatic low-altitude recovery system is also embodied. At altitudes below 15,000 ft., the Q-2C automatically enters a power-off climb gaining altitude until the airspeed drops to 180 knots; then the drag and main parachutes deploy together and the Firebee is lowered gently back to the ground.

In the event of engine, or generator, failure at altitudes above 15,000 ft., the electrical circuit of the drone automatically switches to battery power and it enters a glide. During this period, the radio command link and the autopilot system remain operational and the target is guided into the recovery area by the remote control operator. In the event of loss of signal or low battery voltage, recovery is automatic.

In normal operation, level flight is accomplished and maintained by the automatic control and stabilization equipment installed in the drone. The heart of the system is an autopilot designed to stabilize the drone in flight and to respond smoothly and accurately to radio command signals supplied to it. Interlock features are provided by relays in the circuits in order to isolate certain commands from contradictory or adverse command signals, and to prevent spurious signals from being introduced. These features are, of course, common to both the Q-2A and Q-2C.

In the absence of commands, the drone will maintain stable flight, holding a prescribed heading and altitude. It is also capable of maintaining a circular flight path, holding altitude as desired and a degree of bank best suited to its operating altitude. Flight control, stabilization and manœuvre, are accomplished by operation of the ailerons, elevator and trim rudder.

The trim rudder is positioned by a command to its servo actuator by an impulse received and passed to the actuator



A U.S.A.F. recovery crew having landed by helicopter prepares to air-lift a Q-2C Firebee back to base.

through a mixing circuit ("demultiplexer") which has received a signal from the decoder of the radio receiver. The elevators and ailerons are actuated via control linkage by servo mechanisms controlled by the autopilot. In straight and level flight, errors in pitch and roll are corrected by autopilot command.

Climb and dive commands, given by the remote controller through the radio receiver and mixing circuits to the autopilot, result in movement of the elevators to provide the desired angle of climb or dive. Turn commands, given by the remote operator, result in predetermined elevator movement to provide a bank angle and pre-set up-elevator. The drone will then turn at this altitude until another command is given.

As an aid to control, a telemetering system in the drone transmits certain performance information to the ground station.

The fuel control system consists of an electrical actuator which operates the engine throttle, an altitude sensing and r.p.m. control, and a fuel shut-off valve located in the fuel supply line. The remote operator is the primary source of information for control purposes.

However, after a "dive" command is received, low-thrust operation is automatically introduced. Also, when recovery is employed, either automatically or by command, an electrically energized solenoid-operated valve is de-energized thereby blocking fuel flow to the engine. Complete stoppage of fuel is automatic when recovery or emergency recovery is commanded.

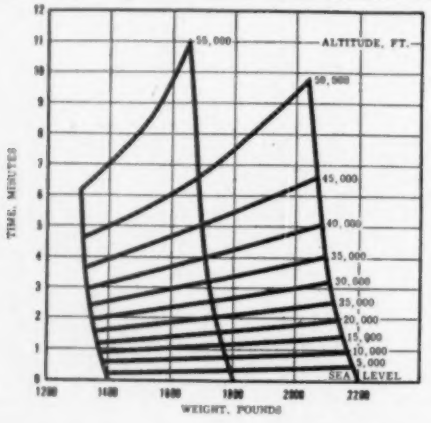
An indication of the Q-2C's performance for extended target missions has been given by the recent achievement of 96.8 minutes of flight under remote control. The drone can be flown under control for approximately nine minutes after its turbojet cuts out, thus enabling the operator to vector its path over a prescribed recovery area.

It says much for the success of this latest version of the Firebee that the Ryan Aeronautical Company has lately received an additional order for the Q-2C amounting to more than $10 million; this will ensure production at the Lindberg Field factory in San Diego, California, until mid-1961. This follows two earlier contracts, one for $2.4 million for manufacture of an initial batch for flight testing and another for $8.6 million for the first production quantity.

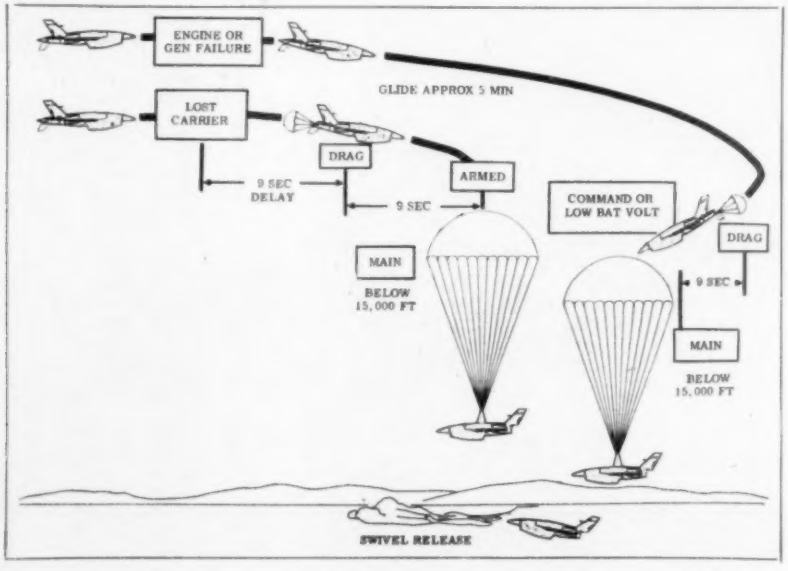
Versions of Firebee have also been produced for the U.S. Army and Navy. XM21 was the first production version ordered by the Army in 1953, while KDA-1, XKDA-2A and KDA-4 have been produced to U.S. Navy specifications.

RYAN Q-2C FIREBEE

Length	22.92 ft.
Wing span	12.9 ft.
Tailplane span	6.75 ft.
Height, overall	6.67 ft.
Weight, gross (basic mission)	2,060 lb.
Weight, fuel (JP-4)	650 lb.
Thrust (J69-T-29 turbojet)	1,700 lb. (sea-level s.t.)



Climb performance of the Ryan Q-2C target drone.



Recovery sequence from high altitude arising from engine or generator failure or loss of carrier signal.

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Fast –
and with precise control,
navigation and
weapon delivery
NA.39
(Two D.H. Gyron Junior engines)
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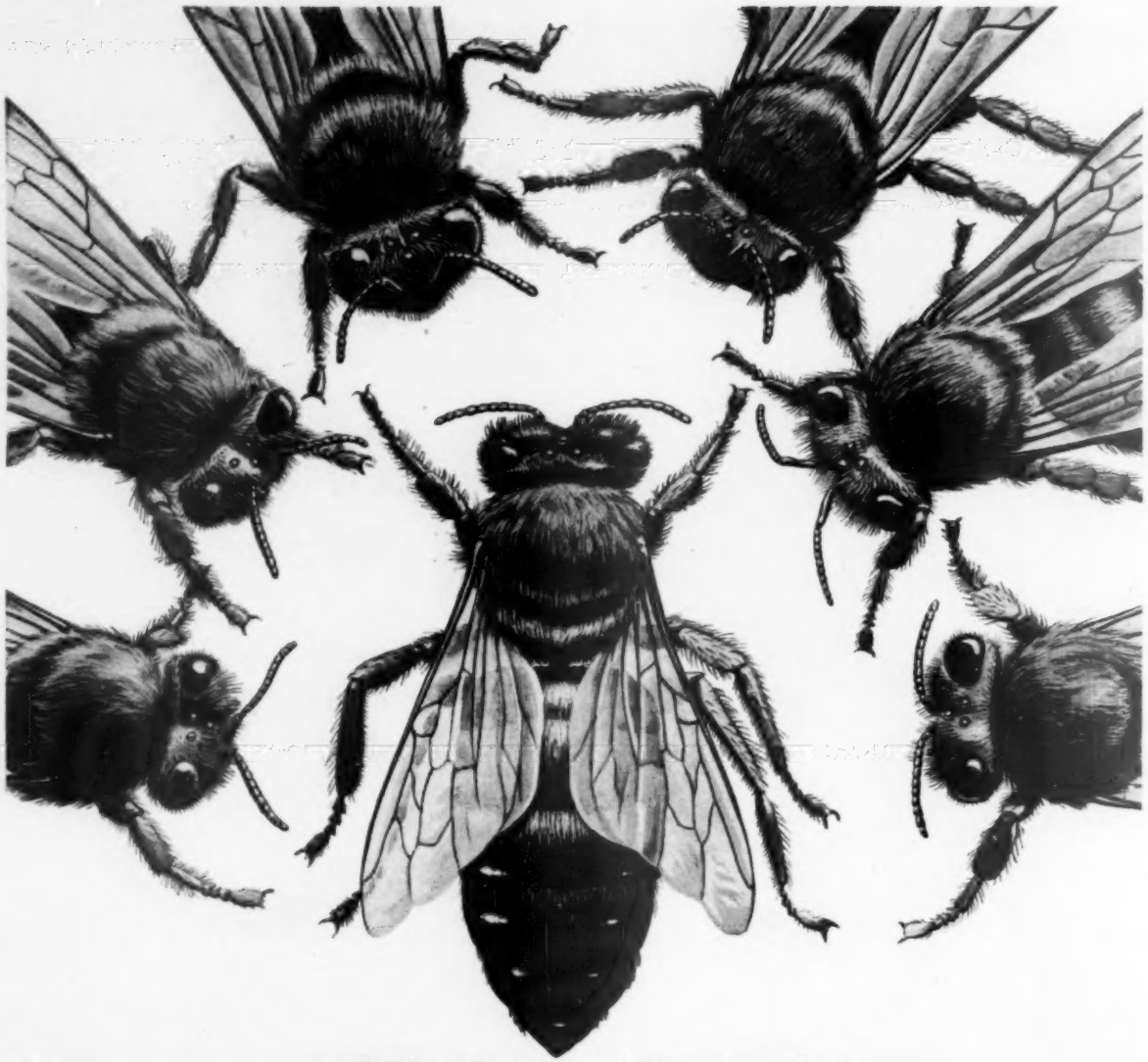

x Minds 1 Thought

What is the third bee from the left thinking about? Supplying the queen.

And the rest? Supplying her too; keeping her at full efficiency, peak productivity.

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AIR BP

THE AVIATION SERVICE OF BRITISH PETROLEUM

Minuteman on Rails

THE U.S.A.F.'s Strategic Air Command is to undertake trials with six special trains equipped to launch Minuteman ICBMs, beginning on Jne. 20 and ending in November. Under present plans, the missile trains would be able to pull into empty sidings in various parts of the United States and launch their missiles within a few minutes.

These trials are intended to demonstrate how effectively missile trains could move back and forth across the country and to show that such a system would be invulnerable to surprise attack.

Sunflower I

A NASA contract to develop a solar auxiliary power system for space-vehicles has been awarded to the Thompson-Ramo-Wooldridge group. Called Sunflower I, the system is intended to generate 3,000 W. of electrical energy continually for one year and has potential uses in Earth-satellites and in lunar and interplanetary space-vehicles. With a total weight of 700 lb., the power unit is designed to fit inside nose fairings being developed for the Centaur and Saturn space-boosters.

Sunflower I will consist of a large folding solar collector, a boiler employing solar energy to heat a "working fluid" of liquid mercury, a turbo-generator driven by the mercury vapour to produce electricity, and a condenser/radiator to dissipate heat. The petal-type solar collector—a bowl-shaped parabolic reflector—unfolds to a diameter of about 32 ft. Mounted on a tripod extending about 20 ft. from the centre of the bowl is a boiler upon which the reflector concentrates the Sun's heat. Mercury, vaporized in the boiler, flows to the 30 lb. turbo-generator; this is a modified version of the SNAP-2 unit being developed by the Atomic Energy Commission for use with a nuclear reactor heat source.

The large condenser/radiator converts the mercury vapour back into liquid by radiating heat into space and will be capable of operation in weightless conditions. Included in the system is also a thermal energy storage unit which will permit continuous power output even when the space-vehicle is in the Earth's shadow.

In operation, Sunflower I will require an orientation and attitude control system to keep the solar reflector pointed at the Sun with less than 1° deviation.

Still no Soviet Astronauts?

SOVIET scientists are still insisting that there is no urgency in putting men into space. In a review of space developments by Prof. Georgi Petrovich which recently appeared in the Journal of the U.S.S.R. Academy of Sciences, he says ". . . manned flights into outer space do not represent the main or even a priority task." Such flights, he goes on, would be made only to solve problems beyond the possibilities of automatic equipment.

Nevertheless, it is difficult to believe that this problem is being neglected in the Soviet Union and, indeed, a large number of photographs purporting to show Soviet "human guinea-pigs" undergoing various space-medical experiments have been published. In the American Press, there have even been reports that man-carrying ballistic tests have already taken place—unsuccessfully.

However this may be, there are probably two reasons for Soviet reticence on this subject. First is the magnitude of the task of re-entering an orbital vehicle under control (and the necessity to diminish the expectancy of early results following the spectacular Soviet success with satellites and space-probes). Second is the genuine opinion—shared by many scientists of East and West—that a great deal of initial exploratory work in space and on the Moon and planets can be accomplished by purely automatic means.

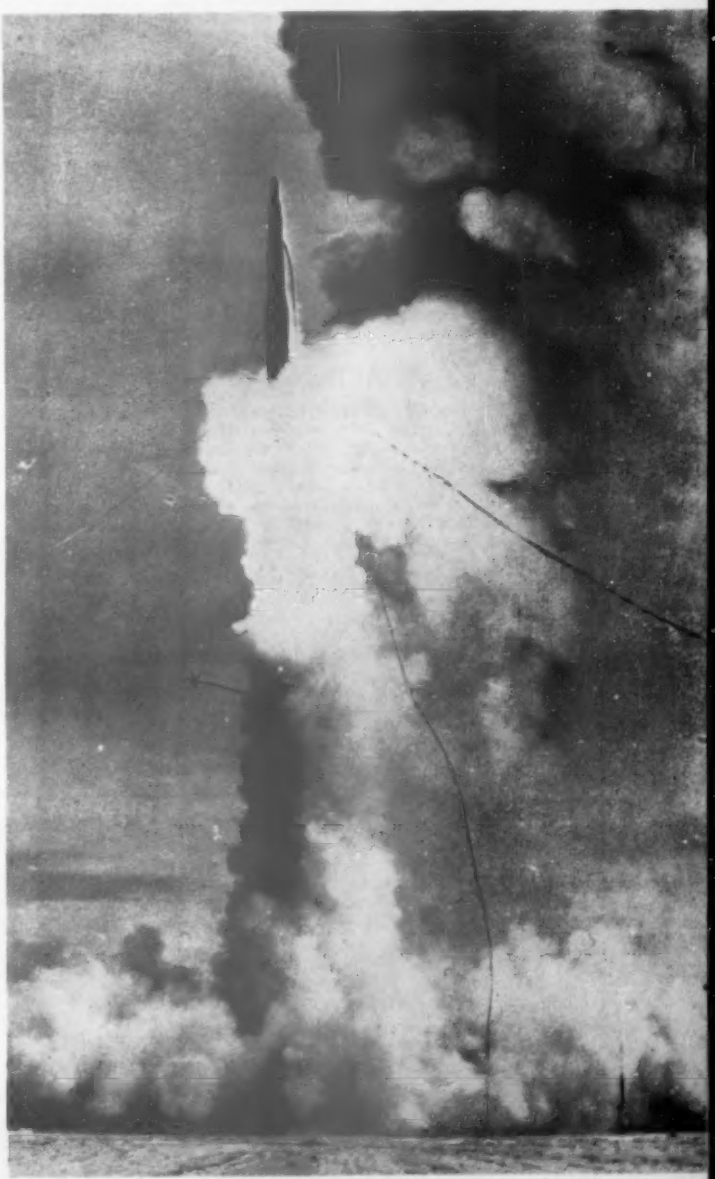
This latter point is brought out fully in the article by Prof. Petrovich. The system for landing a rocket on the Moon, he says, should operate independently of instruments on Earth. The control equipment must be in the rocket itself because it takes radio signals 2.6 sec. to make the double journey, while a smooth landing calls for response time in the control system of the order of hundredths of a second.

Even the choice of landing site, according to the Professor, can be made automatically by equipment installed in the rocket which would control the retro-rockets during approach to the lunar surface.

Prof. Petrovich also raises the question of contamination of the landing area. "In the process of landing, the lunar surface immediately below the landing vehicle will be shattered and melted by the jets of hot gases issuing from the retro-rockets. Consequently, analysis of the local surroundings will not give authentic information about the Moon's rock mantle."

For this reason, he says, following the landing, the automatic scientific station must be able to move at least a dozen yards away from the rocket if the surface is of hard rock, and hundreds of yards at least if it is covered with dust. It will be recalled that the Soviet scientist Yu. S. Khlebtsevich proposed several years ago the idea of a "tankette-laboratory" which, having been landed on the Moon by an automatic rocket, would emerge from the carrier under command control from Earth and conduct independent investigations of the lunar surface (THE AEROPLANE AND ASTRONAUTICS, Oct. 23, 1959, p. 388).

Meanwhile, Prof. Blagonravov has said that "extensive biological studies are planned in preparation for human travel in space." Experiments will be made into the effects of cosmic radiation on living organisms and of methods of protection, involving the launching into space near the Earth of special equipment containing plants and animals.



TETHERED MINUTEMAN.—A test-vehicle for the Minuteman ICBM is launched from an underground "silo" at Edwards Air Force Base, California. Cables are used to restrain the missile from free-flight after it has risen several hundred feet.

The Fighting Services

Director of Operational Requirements

GROUP CAPTAIN I. G. ESPLIN, O.B.E., D.F.C., has become Director of Operational Requirements (A) at the Air Ministry, with the acting rank of Air Commodore.

Completing the R.A.F. Staff College course at Bracknell in 1949, he afterwards remained on the Directing Staff. In 1952 he became Wg. Cdr. in charge of Flying at R.A.F. Wahn, Germany, and there formed the first Meteor night-fighter wing in 2nd. T.A.F. He took the 1954 course at the R.A.F. Flying College, Manby, and served in the Directorate of Operational Requirements before taking over the command of R.A.F. Wartling two years ago.

Thor Bases Completed

INSTALLATION work at the last of the Bomber Command Thor IRBM complexes, which has its headquarters at R.A.F. North Luffenham, has now been completed by the Douglas Aircraft Co. A special ceremony to mark the occasion was held at the base on Thursday, May 5.

Air Marshal Sir Kenneth Cross, the C.-in-C., accompanied by Gen. D. B. Westover, Commander of the 7th U.S.A.F. Air Division, inspected a parade of R.A.F. and U.S.A.F. personnel which was attended by employees of the Douglas Company. During the ceremony Sir Kenneth presented an inscribed Bomber Command plaque to Mr. A. E. Raymond, senior vice-president, engineering, of Douglas, who gave an oil painting of a Thor site to the C.-in-C.

The North Luffenham Thor complex is expected to be classified as operational in the very near future. Similar to the other three R.A.F. units which reached this status in December of last year, it comprises five squadrons located at the headquarters unit and four satellites. There are three Thor launching pads to a squadron, so that North Luffenham will have 15 missiles under its control.

The four completed complexes therefore comprise a total of 20 strategic missile squadrons and provide the Service with 60 operational Thors.

A Record Year

THE University of Birmingham Air Squadron held its Annual Dinner in the Priestley Hall, Guild of Undergraduates Union, on Tuesday, Apr. 26. Among the guests were the Vice-Principal of the University, the Rev. Professor G. W. H. Lampe; Professor A. L. d'Abreu, Dean of the Faculty of Medicine; Professor F. W. Shotton, Dean of the Faculty of Science; Air Marshal Sir Patrick B. Lee Potter, Director General of R.A.F. Medical Services; and the A.O.C., No. 25 Group, Air Vice-Marshal J. F. Hobler.

In proposing the toast to the guests, SQN. LDR. J. D. COTTER, D.F.C., the Commanding Officer of the Squadron, pointed out that, despite the distance of the Squadron's flying base at R.A.F. Shawbury from Birmingham, more hours had been flown during the past twelve months than were on record for many years. The unit was extremely proud of its accident-free record, which stretched back to March, 1956.

Replying to the toast, AIR MARSHAL SIR PATRICK LEE POTTER said that, although the accent today was on missiles, the human element in aircraft could not be superseded. The sea was now being used as a medium for the launching of missiles, but it had obvious restrictions, whereas the air was limitless. He paid tribute to the spirit of the men who fly the machines in the Service, and spoke of his close association with them during his 32 years of service.

In proposing the toast to the Squadron, the REV. PROFESSOR LAMPE said that this was not the first time he had had this honour, but on each occasion it was more forcibly brought home to him that the Air Squadron played a valuable part in the "bringing together and sense of comradeship" amongst the undergraduates of a non-residential university. The toast to the Squadron was replied to by PLT. OFF. E. C. MACKENZIE.

After the dinner the Priestley Cup for the best all round cadet of the year was presented to Cdt. Plt. C. D. M. Rudder, and the Deakin Trophy for aerobatics was presented to Cdt. Plt. J. A. Morton.

R.A.F Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. F. E. Barnes, Wg. Cdr. W. T. Mathieson and Wg. Cdr. R. A. Simpson to the Department of the Chief of the Air Staff; Wg. Cdr. K. W. C. Bindloss to the Department of the Air Member for Personnel; Wg. Cdr. L. B. Davey and Wg. Cdr. W. H. Newman to the Department of the Air Member for Supply and Organization.

Fighter Command: Sqn. Ldr. F. Jesson to the United Kingdom Air Traffic Services H.Q. for trials and development duties, and Sqn. Ldr. R. J. H. Uprichard to R.A.F. Buchan for operational duties, both with acting rank of Wg. Cdr.

Transport Command: Wg. Cdr. W. K. Greer, A.F.C., to Headquarters for operations duties.

Flying Training Command: Gp. Capt. E. L. McMillan, A.F.C., to R.A.F. Valley to command; Gp. Capt. H. A. F. Summers, M.B.E., to H.Q., No. 25 Group, as Senior Administrative Officer; Wg. Cdr. E. Cook, D.F.C., to R.A.F. Syerston as Chief Instructor.

Technical Training Command: Sqn. Off. E. M. Benson, W.R.A.F., to R.A.F. Hawkinge to command, with acting rank of Wg. Off.

Signals Command: Wg. Cdr. E. F. Nind, D.F.C., to R.A.F. Medmenham to command.

Other Appointments: Wg. Cdr. R. Findlater, D.S.O., D.F.C., to Allied Air Forces Northern Europe for exercise manœuvres duties.

More Service News

Staverton Air Display.—The Cheltenham and Gloucester Branches of the R.A.F. Association are organizing an Air Display at Staverton Airport on Jne. 25 from 15.00 to 17.30 hrs. Proceeds will be donated to R.A.F.A. charities.

No. 264 Squadron Reunion.—The No. 264 A.W.(F) Squadron Dinner Club is holding this year's reunion at Beotys Restaurant, 79 St. Martin's Lane, London, W.C.2 on Friday, May 27, at 19.00 hrs. Further details from Flt. Lt. R. C. Olding, R.A.F. College, Cranwell, Lincs.

SERVICE TRIALS.—Lightnings from the English Electric pre-production batch of 20 are now undergoing Service trials with the Air Fighting Development Squadron of the Central Fighter Establishment. Below, a pair flying over their base at R.A.F. Coltishall. Right, an A.F.D.S. pilot wearing a Mk. 1 pressure jerkin and partial pressure helmet.

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in 60 minutes

THE Mk 20 refuelling pack

Tuck a Mk 20 Refuelling Pack under the wing of a single-seat fighter and it becomes a high-ceiling, high-speed aerial tanker. With the refuelling pack, Probe and Drogue in-flight refuelling is possible 40,000 ft. (12,200 metres) up, at 300 knots (566 k.p.h.) indicated, and at the rate of 150 gallons per minute (680 litres per minute).
In just 60 minutes this compact self-powered ram-air turbine driven unit weighing only 800 lb dry weight (363 kgs) can be fitted to standard underwing pylons of fighter and strike aircraft. Removal of the store is even quicker. The refuelling pack's own capacity is 150 gallons (680 litres) but it can transfer as much fuel as the aircraft can carry. It speaks for the simplicity of the controls that the unit can be operated safely from a single-seat aircraft. The refuelling pack is built by Flight Refuelling Limited, the pioneers of the Probe and Drogue in-flight refuelling system.

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TA3651

Personal Flying

The Certification of Light Aircraft

There are many misconceptions concerning A.R.B. certification of light aircraft—particularly American-built ones. Here L. S. WHICHER, A.F.R.Ae.S., *an assistant chief surveyor of the A.R.B., discusses the differences between the U.K. and U.S.A. systems.*

ONE of the important duties of an airworthiness authority is to think, in advance, in terms of the design requirements to which it is to certify new aircraft. This work increases year by year as aircraft become more specialized in themselves and are put to an ever-increasing number of uses.

The foundations of British airworthiness requirements were laid when the Air Ministry published "Air Publication 1208," and this set of rules served its purpose well for many years. It was based upon the draft minimum requirements formulated by the International Commission for Air Navigation (ICAN) which was signed in Paris in 1919.

AP1208 continued in use for a short time after the formation of the Air Registration Board in 1937. The Board first published its own design requirements for British civil aircraft in 1944, and these have been under constant review ever since.

So far the sole example of its type to be imported, the Mooney Mk. 20A is typical of the high-performance American light aircraft now reaching this country in increasing numbers.

In recent years great efforts have been made to agree and standardize design requirements internationally. There have always been, however, certain differences between airworthiness philosophy in this country and in the United States, partly because America was not represented in Paris in 1919 and was not, therefore, a party to the ICAN standards.

For many years only three categories of aircraft have been recognized from a design point of view in this country—the Special Category devised for the certification of research, experimental and other unorthodox aircraft together with those specially modified for racing or record breaking; the Aerobatic Category incorporating special strength requirements; and the Normal Category for all of the remainder. Design standards have, of course, been modified from time to time but until recently the basic design requirements for all Normal Category aircraft have been similar, irrespective of the size of the aircraft and its intended use.

Photographs copyright "The Aeroplane and Astronautics"

The 4-5 seat Helio Courier is a particularly interesting American design with an effective speed range of more than 5:1.

In the United States, with an enormous production of civil aircraft and varied geographical and economic factors, the problem has been handled somewhat differently and there has always been more emphasis on the type of flying to be undertaken. The United States Civil Air Regulations vary as between scheduled transport aircraft, private and executive aircraft, and aircraft used for aerial work or other special purposes.

Furthermore, aircraft under 12,500 lb. do not have to meet transport category standards in many respects; and aircraft for private and executive use do not have to meet the more advanced design and performance requirements applicable to large transport aircraft. This has resulted in different design criteria and separate sets of requirements.

In order to improve the market for the export of all classes of aircraft and to stimulate private and club flying in the United Kingdom, it has become evident that our national requirements should now be suitably modified to take more account of variations in size of aircraft, and particularly the duties which they are intended to perform.

The Air Registration Board is at present reviewing its design requirements for aircraft having a maximum all-up weight of less than 12,500 lb. Particular attention is being paid to light aircraft to be used for private and executive purposes.

It is expected that a forthcoming revision of the Air Navigation Order will legalize the certification of aircraft in five distinct categories directly related to different classes of flying. This will make for increased flexibility in the certification of new types, and will simplify the problem of the certification of ex-military aircraft which do not fully meet current Civil Airworthiness Requirements.

Smallest four-seater of the Cessna high-wing range is the 145-b.h.p. Model 172.

Publication of separate design requirements for the smaller types of aircraft will, it is hoped, cheapen the production of such aircraft by allowing the use of commercial materials for a number of purposes. It will also provide an opportunity for revision of the requirements concerning instruments and equipment so that satisfactory and well-proven commercial items can be utilized without having to subject them to full "release" procedure.

Work is proceeding on a basic simplified Flight Manual applicable to aircraft with an all-up weight of less than 5,000 lb. and this will not only reduce the cost of the initial preparation of this mandatory document but will, it is hoped, provide a standard pattern for international acceptance. Simple performance tables will take the place of graphs where possible and the limitations will be restricted to those essential for safe operation.

These are positive steps to separate the private and light executive aircraft from the large passenger transport, from a design requirement point of view. Carried to their logical conclusion, it is possible to foresee separate and independent design and performance requirements for aircraft used for passenger transport, freighting, private and executive duties, aerial work, and possibly even those in the ultra-light class.

There is little doubt that this trend towards making the rules

fit the job rather than vice versa will not only be of benefit to all those concerned, but will assist towards the ultimate aim of international reciprocity. With the co-operation of the constructors and users the policy is one that can be carried out without lowering the general level of airworthiness of British light aircraft.

Certification of American Aircraft

As already mentioned, there are considerable differences between the certification systems currently operating in this country and in the United States. American light aircraft, with a maximum all-up weight of less than 12,500 lb. and constructed primarily for private and executive use, are certified in the United States to Part 3 of the Civil Air Regulations.

These Regulations do not require the performance of the aircraft to be scheduled; it is left to the constructor to supply the customer with basic performance information and this is done in the form of an Owner's Handbook or Pilot's Notes. Such performance information is not subject to official check, is usually accurate though brief, and may not take into account the effect of altitude and temperature.

The large majority of the enormous output of this class of aircraft in America is used only for private and executive purposes, but any such aircraft *can* be used for the public transport of passengers, provided additional requirements are satisfied. One of these additional requirements is that the operator (not the constructor) must satisfy the Authorities that the aircraft has sufficient performance, under all conditions, to operate over the route or routes that he proposes to "ply for hire."

Thus the amount of performance information required by American law varies according to the individual operator, the routes for which an operating licence is required and the nature of the terrain and climate normally encountered over those routes. The operator must either obtain this additional information from the constructor of his aircraft or, alternatively, measure it himself.

In this country there is no distinction in law between aircraft above or below a maximum weight of 12,500 lb. The United Kingdom Air Navigation Order requires the operator of *any* aircraft used for public transport to have available approved and comprehensive performance information without regard to the particular operations to be undertaken.

Furthermore, instruction in flying, for which payment is made, has always been regarded as public transport. The official view is that a trainee or club member, because he is paying for his flying, is entitled to the increased protection afforded by public transport requirements.

Because the performance information required by the Air Navigation Order must be officially approved and because even light aircraft in this country are likely to require public transport clearance, the constructor supplies all the necessary performance information before certification which results in the issue of a Certificate of Airworthiness with an associated and approved Flight Manual or, in the case of some of the older types of aircraft, a Performance Schedule.

Although the official attitude towards the importance of adequate performance data does not differ very much between the airworthiness authorities of the United Kingdom and the United States, it is the different domestic procedure described above which has caused the major difficulty.

The importation of American light aircraft with a maximum weight of under about 6,000 lb. to be used for private or executive purposes in this country now presents no problems because the Air Registration Board has recently indicated that it will accept Part 3 of the Civil Air Regulations as equivalent to its own requirements for this class of aircraft. No special conditions will be imposed and the Board will recommend validation without modification or any additional information

One of several very attractive American light "twins" is the Beech Travel Air, of which G-APUB is the first British example.

The degree of sophistication in American lightplane engineering is illustrated by the fact that about 90% of the Piper Comanches now flying are equipped with a single-axis autopilot, the use of which is shown by this in-flight photograph.

over and above that normally supplied by the constructor (except records relative to past maintenance in respect of second-hand aircraft). But—and here we come to the heart of the problem—the performance information supplied by the average American light aircraft constructor has, in the past, been totally inadequate to meet the requirements of the Air Navigation Order for public transport operations.

Much energy has been expended both by the importers and by the A.R.B. to solve this problem involving direct liaison with the American aircraft constructors concerned and with the United States airworthiness authorities. Up to a short while ago, however, the number of aircraft sold to the United Kingdom had been so small, compared with the total output, that a somewhat "take it or leave it" attitude has been all too apparent. In spite of the fact that precise details of exactly what is required to meet U.K. law applicable to public transport operations were drawn up and were communicated to Washington and to individual constructors, new aircraft still arrive with little or no performance data.

However, the recent lifting of import restrictions in this country has caused the American light aircraft industry to step up sales pressure in England and Western Europe and there is now every sign that future aircraft imported, at least from the major American constructors, will be accompanied by adequate performance information. This can result in immediate acceptance for United Kingdom validation for all purposes.

The only other major problem affecting the importation of American light aircraft for public transport duties is that of radio and navigational aids about which there is a good deal of misunderstanding and ill-informed criticism. As there are no requirements in America governing radio and navigational aids in aircraft used for private and executive purposes, much of the "lightweight" equipment installed is apparatus that has not been subjected to any official approval or test. There are many different types and reliability and performance varies enormously and often the "build" standard leaves much to be desired.

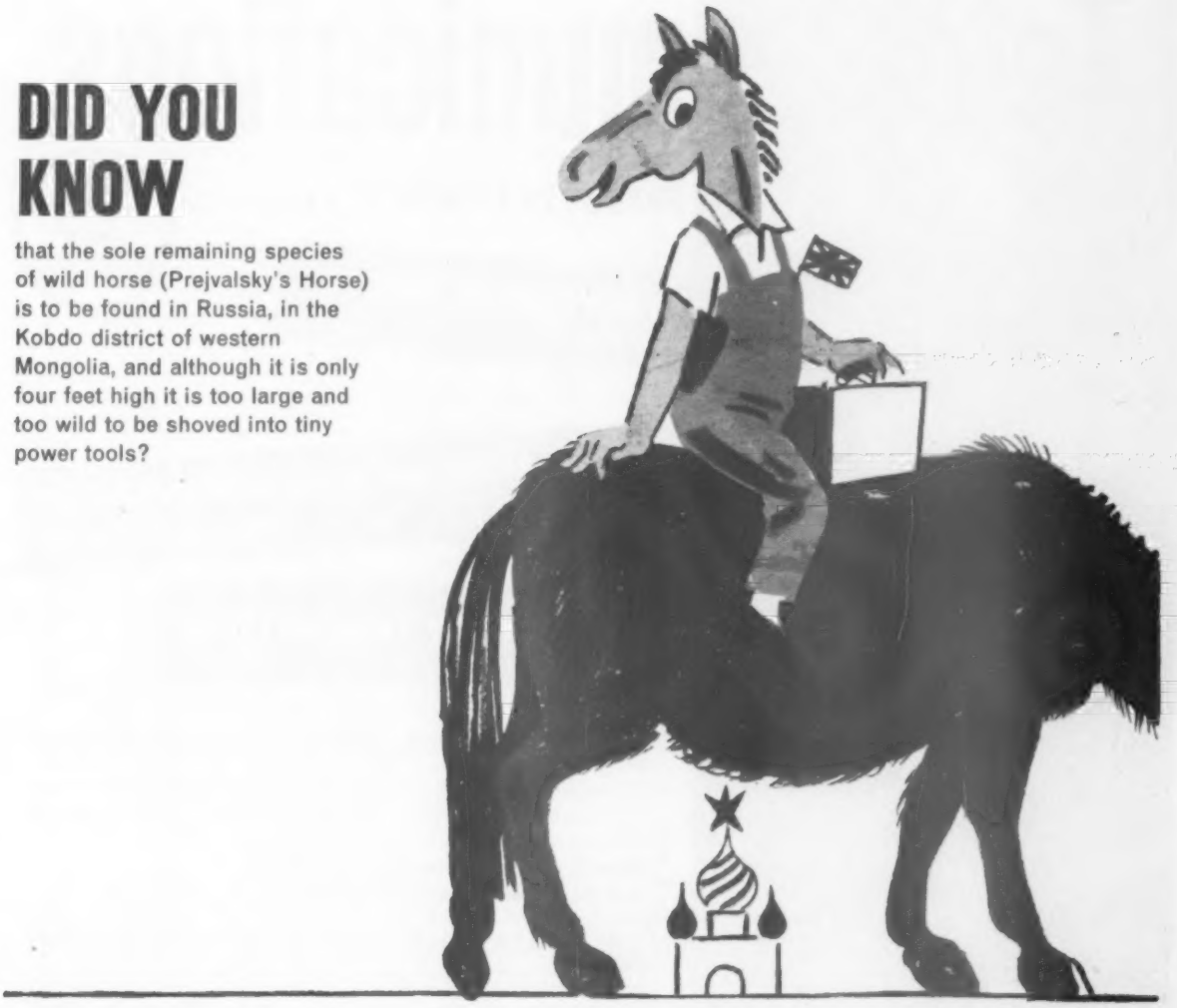
Radio installed in *all* aircraft on the U.K. Register must be of a type acceptable to the Telecommunications Department of the Ministry of Aviation, and its installation in the aircraft must meet the requirements of the A.R.B. These two factors combine to make the radio "station" eligible for the G.P.O. licence required by law.

Some types of American "lightweight" equipment have been approved by the Ministry for use in private and executive aircraft which have a maximum all-up weight of less than 5,000 lb. and the Ministry is always prepared to advise regarding any new type of apparatus of this kind. Full public transport operations must obviously necessitate the installation of fully approved and tested apparatus of a type suitable for use with the ground equipment installed in this country.

The work involved in negotiation between the United Kingdom and the United States airworthiness authorities in respect of the acceptance of each other's large transport aircraft, has been the subject of a good deal of publicity over the past few years. It is perhaps no less important that the light aircraft problem should be properly understood so that all interested organizations in this country can co-operate to make the best possible use of the aircraft now becoming available.

DID YOU KNOW

that the sole remaining species of wild horse (Prejvalsky's Horse) is to be found in Russia, in the Kobdo district of western Mongolia, and although it is only four feet high it is too large and too wild to be shoved into tiny power tools?



AND DID YOU KNOW

that because Prejvalsky's Horse is too large and too wild to be shoved into tiny power tools Desoutter Little Horses (which are tiny and tame and *can* be shoved into tiny power tools) are imported by Russia in large quantities?

No, I didn't know, said the M.D. No-one ever tells me anything!

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Personal Flying . . . .

Flying the Cessna 150

by John Fricker

HAVING dealt with the largest of the Cessna single-engined range—the Model 210—in our issue of Apr. 15, and followed this last week with an assessment of the Model 175, it now remains to discuss only the two-seat Model 150, of the aircraft which were being shown in the Cessna high-wing circus at Kidlington last week-end.

In the case of the Model 150, which is the smallest and cheapest of the range, a prolonged acquaintance extending over six or seven hours' flying, made possible through the courtesy of Airwork Services, Ltd., and W. S. Shackleton, Ltd., the owners of demonstrator G-APXY, gave the invaluable opportunity of a user's assessment. It also resulted in quite a strong attachment for this little all-metal aeroplane, which I think has a strong potential ahead of it as a trainer for the new world of applied, as opposed to pure, aviation.

The emphasis nowadays has inexorably shifted, whether we like it or not, from the art of flying aeroplanes to the skill of operating them. Personally I am all for the more scientific approach demanded by modern conditions, particularly as we at last have the prospects of getting the equipment for this to be achieved.

The Cessna 150 is a scaled-down version of the typically American business aircraft conception. In its lavishly equipped "commuter" form (at £4,184 basic price, U.K. duty paid), it is, in fact, a two-seat executive aeroplane, but it is also available as a trainer (at £3,913), or in standard form, for £3,535. It is powered by a 100 b.h.p. Continental O-200-A flat-four engine, and has all the features of its bigger brethren, such as the powerful NACA slotted and area-increasing flaps, and the spring-steel mainwheel legs on its tricycle landing gear.

G-APXY is without the optional spats for the undercarriage, or the big spinner for the Sensenich fixed-pitch metal airscrew, and is equipped with only basic flight instruments. The commodious panel in the cockpit has ample provision for a full set of blind-flying instruments, however, and in the "inter-city commuter" version, there is a 35 amp. generator to provide the necessary power.

Radio in G-APXY is confined to the little Narco Superhomer, which is an excellent and inexpensive piece of VHF equipment and incorporates a VOR indicator. Reception is tunable from 100 to 126 Mc/s, but the crystals fitted in the transmitter cover only 1½ Mc/s., and the nine channels starting at 121.5 are virtually useless in the U.K. and Europe. It is possible to listen out on most of the frequencies in this country, with excellent reception through the roof loudspeaker, but transmission is extremely limited.

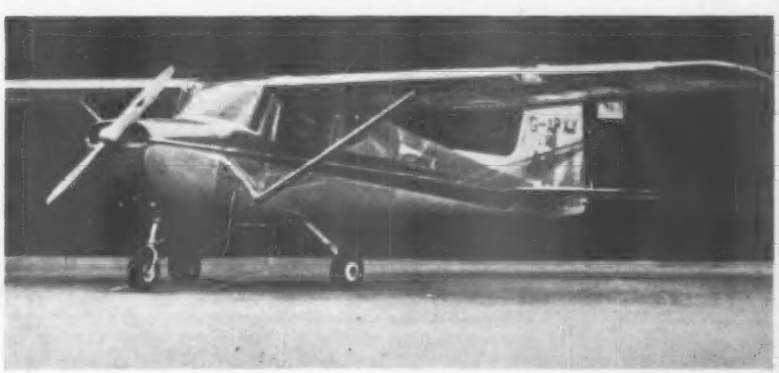
There is not too much room in the cockpit, and two average-sized men definitely occupy all the space between the rather flimsy doors. These each have windows hinged at the top to open outwards, with knuckle-stays at the bottom which tend to intrude further on the limited cockpit width. The bench seat is fixed, and the rudder pedals, with their toe brakes, are non-adjustable, but the seat back can be varied in angle for control reach. For training duties, the lap straps of the 150 are supplemented by a single shoulder strap passing diagonally across the body.

De luxe equipment for the Cessna 150 includes wheel spats, additional instrumentation, a spinner, and an anti-collision beacon.

The only criticism that can be levelled at the instrument layout is that the twin gauges for the two 10½-Imp.-gal. wing tanks, together with the oil temperature and pressure gauges, are poorly located at the very bottom of the panel, where they are obscured by the throttle plunger and other control knobs. With so much room available elsewhere, it is difficult to justify their present location. There is a simple "ON-OFF" selector for the fuel system on the cabin floor, next to the manual flap lever and the elevator trim wheel.

Full marks to Cessna for the latter; longitudinal trim is sensitive but low-geared and the wheel works in the logical plane. Less convenient is the flap lever, which is perhaps too long, and interferes with throttle access during landing. View from the cabin is as good as can be expected from any high-wing aeroplane with no roof windows and rather thick side-frames, and, as the pilot is seated relatively far aft of the windscreen, the 150 feels rather blind in turns.

As a matter of interest, this Cessna is available as a



G-APXY, the subject of this article, is bereft of optional luxuries, but as its cockpit shows, the comfort and range of equipment is adequate for all normal flying including club training.

"patrolling" aircraft, in which 15.8-Imp.-gal. fuel tanks are installed in place of the standard type, and the bottom half of each door is provided with a transparent panel, for improved downward visibility. With the "patroller" wing, range is increased by 50%, and provision is made for a message chute in the floor in front of the pilot's seat.

Except with two bulky people on board, the 150 is very comfortable and pleasant to fly. Great attention has been paid to soundproofing, and such items as forced-flow ventilator tubes which can be pulled out from each wing-root, plus an efficient cabin heater, impart an agreeably luxurious atmosphere. Noise level is low; low enough, in fact, for the thin fuselage skin to be heard "oil-canning" under certain conditions of flight. This is particularly noticeable during the climb, and is slightly disconcerting until tracked down.

In flight, the 150 handles very much like the rest of the Cessna range, although being lighter, it is perhaps slightly brisker on the controls. The ailerons have the family characteristic of a slight lack of crispness, although they are light and pleasant to use. The elevator is heavier and more positive, and a touch of rudder helps to obtain accurate turns.

In short, the 150 has what we have come to know as typically American handling characteristics, with the emphasis on easy, safe and effortless operation. Being produced with pilot training in mind, its stalling characteristics are rather more sharply defined than in the rest of the Cessna range, and it is cleared in the U.S. for spinning. Although positive, the stalls in all conditions are innocuous and straight, varying between about 40 m.p.h. I.A.S. clean, without power, and almost off the clock at about 30 m.p.h. I.A.S., with flap and power.

Aerodynamic warning is slight, but the usual Safe-Flight horn is fitted. This begins to sound intermittently at 5-10 m.p.h. above the stall, and becomes continuous just before it. With its aid, and using hard aft pressure on the wheel, I found that the 150 would spin smoothly to the left, following application of port rudder, at a fairly steep angle. It loses about 300 ft. per turn, but stops rotating before the rudder is completely reversed for recovery.

As the Cessna 150 was the first aircraft with a wheel control which I had spun, it felt slightly odd, but it was easy enough to keep the airspeed fairly low in the ensuing dive. I could not get the 150 to spin to the right in two determined attempts; each time it went slowly into a spiral dive.

I started my spins at 3,000 ft., which solo, with about half fuel, had taken a fraction under five minutes to reach. There is no full throttle limitation on the hard-working Continental, which is red-lined at 2,750 r.p.m., and gives some 2,500 r.p.m. at the assumed climbing speed of 65 m.p.h. I did not have the precise figures for 150 operation, and it is possible that the unspectacular climb was due partly to an incorrect speed. With two up, however, the climb gives a definite feeling of being able to use a little more power.

CESSNA 150

DIMENSIONS.—Span, 33 ft. 4 in.; length, 21 ft. 6 in.; height, 6 ft. 11 in.; wing area, 160 sq. ft.

WEIGHTS.—Empty, 946 lb.; pilot and passenger, 340 lb.; baggage, 80 lb.; gross, 1,500 lb.

PERFORMANCE.—Max. speed, 124 m.p.h.: max. cruise, 70% power, at 9,000 ft., 121 m.p.h.; initial climb, 740 ft./min.; service ceiling, 15,300 ft.; take-off run, 680 ft.; to 50 ft., 1,205 ft.; landing run, 360 ft.; from 50 ft., 1,055 ft.; range, at 70% power, 520 miles ("patroller", 810 miles); endurance 4.3 hr. (6.7 hr.); maximum range, 630 miles (980 miles); maximum endurance, 6.6 hr. (10.3 hr.)

Selecting about 2,300 r.p.m. as a good cruising setting resulted in a cross-country speed of about 105 m.p.h. I.A.S. at about 2,000 ft., which comes out at rather more at the rated altitude. The 150 can be trimmed accurately and its stability is such that when flying over a turbulent South London, I found no necessity to touch the control wheel for 10 minutes at a time.

This impressive stability remains apparent during the landing approach, which, with a little familiarity, can be done, power off and full flap, in virtually a dive-bomber attitude. In the vicinity of the runway threshold at about 800 ft., the full 40 degrees of slotted flap can be lowered, below 85 m.p.h., and the nose dropped very steeply to maintain 60-65 m.p.h. A few turns of aft trim enables this to be done hands-off to within a few feet of the ground, when the responsive elevator will achieve the necessary flare-out.

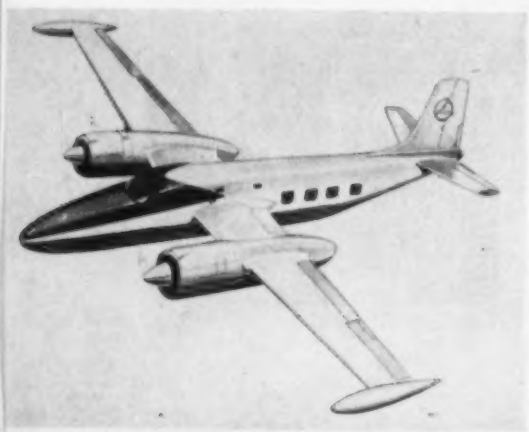
Possibly because of their extensive flap area, the Cessnas are rather like low-wing monoplanes in tending to sink gently to the ground, almost regardless of the landing technique adopted, and the spring-steel undercarriage irons out even the roughest of turf with very little pitching. Nobody who has tried the positive ground control obtainable with a steerable nosewheel and powerful toe brakes will voluntarily return to a tailwheel undercarriage, except possibly for specialized operations.

I returned the little 150 to Kidlington with genuine regret, having flown it to Stapleford, Blackbushe and Goodwood during the excellent Easter weather and found it the sort of aeroplane which is almost as easy to drive as a car and yet inspires confidence to get into and out of virtually anywhere. In the first year of its production from 1959, more than 700 Cessna 150s were sold, and the type is obviously a strong contender in the World market as a standard club trainer and light utility aeroplane.

Executive Tempo

THREE executive transport conversions of the Douglas B-26 light bomber are being offered by L. B. Smith Aircraft Corporation, at prices ranging from $250,000 to $440,000 (less radio and electronics). The apparent success with which quite elderly and apparently unsuitable military aircraft can be adapted in this way is a reminder of the enormous market among U.S. corporations and business houses for executive aircraft. The appeal of the B-26, which was developed as a successor for the A-20 Boston but was just too late for Wartime service, lies mostly in its high cruising speed, equalled only by the new turboprop and turbojet types.

L. B. Smith Aircraft, of Miami, has previously been responsible for engineering changes to the Curtiss C-46 Commando twin-engined transport to meet current regulations. Of the B-26 conversions, that known as the Tempo II is the most extensive, and retains only the wings, control surfaces and nacelles of the original Douglas aeroplane. The new fuselage is 7 ft. 9 in. longer and 1 ft. 3 in. deeper, providing a constant interior height of 6 ft. 2 in. over the entire 28-ft.-long cabin. The fuselage is pressurized to a differential of 4.17 p.s.i., using standard components and accessories.



An artist's impression of the Tempo II.

To allow a completely uninterrupted cabin, the wing attachments have been redesigned, eliminating the two spars which originally passed through the fuselage. Instead, fuselage spar frames of 1¼-in. rolled aluminium alloy plate take the wing loads round the cabin. The wing span is increased by 20 in. and the area by 18 sq. ft. Tip tanks are provided as standard and optional outer wing panel tanks can be installed. The long fuselage nose provides for weather radar and contains a baggage hold and a cabin heater.

Two 2,100 h.p. Pratt & Whitney R2800-C engines are installed, and the Tempo II will be certificated under CAR9 with all changes and modifications in accordance with CAR4b.

Flight trials with the first production Tempo II began late last year. The longer fuselage, moving the tail farther aft in relation to the wings, has had the effect of reducing minimum control speeds, while the increased fineness ratio of the fuselage and better streamlining offsets the greater drag of the increased wetted area. Estimated performance figures, which are now being confirmed, indicate a cruising speed of 350 m.p.h. at 20,000 ft. at 31,000 lb. on 67% power, an initial rate of climb at max. weight (35,000 lb.) of 1,650 ft./min. at sea-level, and a single-engined rate of climb at max. weight at 5,000 ft. of 300 ft./min.

A typical Tempo II interior provides accommodation for 10 passengers and includes a full-size toilet and a galley. The price with custom interior but without radio and electronics is $440,000. Delivery of the second production Tempo II to General Mills, Inc., was scheduled for this spring.

Customers not requiring a pressurized fuselage can buy the Tempo I and save about $100,000. The fuselage of the Tempo I will, however, be pressure-sealed so that it can be converted to Tempo II standard later if required. Cheapest of the range is the Biscayne 26, which has a fuselage 5 ft. 10 in. longer than the B-26 and the revised wing attachments of the Tempo series, but is unpressurized. This will sell for $250,000 with a 10-passenger interior.

Gliding Notes

by Dr. A. E. Slater

FROM Dunstable on Saturday, Apr. 30, three members of the London Gliding Club set out to fly to the Long Mynd and back, 110 miles each way. Anyone who succeeded would have beaten the U.K. Local Record for goal-and-return by 23 miles, but would have beaten the British National Record, which is held by R. C. "Jock" Forbes with a flight in America, by only three miles, which is insufficient margin for official recognition.

As it turned out, Geoffrey Stephenson came nearest to doing so, as he got back as far as Thame. Colin Richardson, who had made 162 miles to Cranwell and back nine days earlier, covered 190 miles this time before landing at Kidlington on the way back after 7¼ hours in the air. The third pilot, John Jeffries, missed the Mynd and landed at Welshpool, 15 miles beyond.

There was some excuse for losing one's way, as the haze was so thick that Richardson said he could not see the ground at all from above 2,000 ft., and even at 3,000 ft. he was still surrounded by thick haze so that there was no visible horizon, and the distribution of the cumulus, which had bases at 4,500 ft., could not be made out. There was worse clag south of Birmingham, but in the region of the Long Mynd the going was extraordinarily good, so that the haze must have been transparent to heat rays even if not to visual wave lengths. He made the first 40 miles of the return journey in 45 min.

Along the route from Lasham to Cornwall, visibility was rather better, and the going was fairly good at first along the 300-km. route to Perranporth. But then a sea breeze came drifting in from the North Devon coast and spoilt it all, so that Stuart Morison with an Olympia 419 came down after 160 miles, Rika Harwood landed at Callington after 150 miles and Ron Willbie at Okehampton after 137 miles.

* * *

LES HUIT JOURS D'ANGERS is an annual French contest open to foreign pilots. The tasks are out-and-returns and races round triangles, and the period is Jly. 2-10, with Jne. 1 as the closing date for entries.

Entries to gliding contests overseas are usually sponsored by the British Gliding Association, which is therefore able to insist that they can be made only by pilots who are on the seeded list for World Championships. However, no seeded pilots have applied to go to Angers, so others can now apply, though probably only one team from each country will be allowed.

From the British Embassy in Madrid the B.G.A. has heard that seven British pilots can be taken this year at the Spanish gliding school at Huesca, in the foothills of the Pyrenees.

A year or two ago, Spain issued a free invitation for three Irish pupils to take a course at Huesca, as a sort of gesture of solidarity. But only two Irish glider pilots could accept, so S. C. O'Grady, who has long been associated with the Newcastle Club, joined the party. There was something of a hold-up when he was found to have a British passport, but after much argument he managed to get by on his good old Irish name.

* * *

THIS year, from Mar. 26 to Oct. 9, the Swiss Met. Office at Zurich Airport is once again laying on special weather forecasts for glider pilots applicable to the Jura, Central and Lower Alpine regions. They can be heard on magnetic tape by dialling the appropriate number.

The day's forecast can be got any time after 06.00 hrs. on Saturdays, Sundays and public holidays. But if you are one of the planning sort, you can get an earlier forecast at any time during the night, starting at 18.00 hrs. the previous evening. The forecast covers the general situation and expected development, cloudiness, height of cloud bases and tops, thermals, inversions, maximum surface temperature expected, and wind at three different heights.

But this is not all. The broadcast finishes with lists of temperatures and dew points at various heights reported by radio-sondes at several met. stations, not only in Switzerland but abroad, for the benefit of long distance aspirants, though they will have to enter all this up on tephigram forms before it means anything.

* * *

FROM the German Aero Club the latest list of World Championship entries to arrive contains 27 entries in the Open Class and 40 in the Standard. (In 1958 there were 37 Open and 24 Standard.) The latest additions are from Argentina, which has José Ortner and Rudolfo Hossinger in the Open Class, each with a Skylark 3, and Julio Arteman in the Standard Class with a Skylark 2.

Entrants from afar who cannot bring their own machines are each being loaned a Zugvogel 3 in the Open Class (Israel and Japan) and a Ka 6 in the Standard Class (Australia, Canada, Southern Rhodesia, Brazil, Iceland, and Spain).

In the Open Class 19 nations are represented, and in the Standard Class 26; the total number of nations is 27. In Poland two years ago there were 22.

Perhaps the most unconventional machine this year, because of its plastics construction, is the Phönix, Germany's only entry in the Open Class, to be flown by Ernst-Günther Haase, the present World Champion. Among several differences from the original 1958 model, is the raising of the tailplane to a position above the rudder.

* * *

AT the Clwyd Gate Café near Ruthin, in North Wales, "Bill" Crease is entertaining a succession of gliding parties as usual. Early in April Mike Russell and Roger Bradford arrived from the London Club with their Petrel and logged 20¼ hours in five flights, all exceeding 3 hr. duration and 3,000 ft. altitude. In one flight lasting 7 hr. 12 min. Russell climbed "in mixed thermal and wave" to 8,500 ft., but as he did it out of sight at the Prestatyn end of the ridge, his crew set off eastward across England until frantic calls to the police located them in Shrewsbury.

Bill Wills and, later, a big party from Farnborough in charge of David Martlew, are also booked for spring visits to Clwyd.

* * *

THE loss of Dr. August Raspet in a flying accident on Apr. 27 in the United States is a severe blow to the scientific future of soaring flight. But he had already done brilliant work which has had a lasting effect on sailplane technology. His best known work was done on the aerodynamic hotting-up of the RJ-5 sailplane, whereby its gliding angle was improved from about 1 in 30 to something like 1 in 44, with the result that in 1951 Dick Johnson set up a World's distance record of 535 miles, which still remains unbeaten.

One of his lesser known projects was the accurate measurement of the performance of the black buzzard, which he did by following it in a British Kirby Kite sailplane, the only one in America which could be flown slowly enough for the purpose. He found that, while circling in thermals, the bird had much the same performance as a sailplane; but when it glided in a straight line from one thermal to the next, with its primary feathers closed up, it easily beat the sailplane.

Raspet concluded that it must have established laminar flow over its entire body and wings combined, for its drag coefficient was reduced from 0.019 (the figure for flying with primary feathers separated) to 0.0058. He computed that the bird, which weighed 2.3 kg., needed only 0.019 horse-power to maintain level flight at 31 m.p.h.

GERMAN SAILPLANE.—Produced by Apparatebau Nabern, a Bölkow subsidiary, this Phönix FS 24 high-performance sailplane was exhibited recently at Hanover; a later version will be flown in the World Championships by Ernst-Günther Haase.

Photograph copyright "The Aeroplane and Astronautics"

Aviation News in General

A.129 NAMED.—The M.o.A. has approved the name of Nimbus for the Blackburn A.129 engine which has been ordered for a pre-production batch of Saunders-Roe Wasp helicopters for the Army. A considerable amount of flying has been undertaken by the Nimbus in the Wasp during recent months.

LAST PROVOST DELIVERED.—With the recent delivery of a Hunting Provost to the Irish Air Force, the basic trainer's production at Luton has finished. Altogether 461 Provosts have been delivered since the prototype first flew on Jan. 24, 1950.

ALIZE ORDER.—The Indian Navy has ordered a squadron of Breguet Alizé anti-submarine aircraft (R.-R. Dart engine), for service aboard its first aircraft carrier, together with two squadrons of Sea Hawks.

AIRCREW TRAINING.—The present Canadian aircrew training agreement with Norway has been extended for four years starting on Jly. 1, next. Training to "wings" standard will be provided annually to 30 student pilots and three navigators at a token Norwegian payment of $5,000 for each pilot and $2,000 for each navigator.

MAIDEN FLIGHT.—The Dassault Spirale which made its first flight on Apr. 8 piloted by Paul Boudier. Powered by two Turboméca Bastan turboprops, it is a development of the MD.415 Communauté and designed for transport, reconnaissance and ground-attack duties in North Africa.

SPACE COSTS.—The total sum involved in launching Pioneer V into orbit around the Sun was about £5 million, according to Dr. Hugh Dryden, NASA's deputy administrator. A similar amount was quoted for orbiting the Earth-satellite Tiros I.

FUEL CONTRACT.—Air BP has signed a contract to supply Malev, the Hungarian National Airline, with all its fuel and service requirements at western airports. The company has also signed a contract to supply through Malev the total aviation gasoline requirements for western airlines at Budapest.

WEATHER EYE.—The U.S. Weather Bureau reported on Apr. 10 that the Tiros meteorological satellite had discovered the existence of a fully developed typhoon about 800 miles east of Brisbane, Australia. A telegram was sent immediately to the Australian Meteorological Bureau warning them of the typhoon which apparently had gone unnoticed.

MEGAPOUND FURY.—First static test of the Saturn booster with all eight Rocketdyne H-1 engines firing occurred at ABMA's Redstone Arsenal, Alabama, on Apr. 27. The booster developed a total thrust of 1.3 million lb. Previous tests had been run with two and four engines.

MARS RECONNAISSANCE. — A space-probe capable of orbiting the Sun and passing within 5,000 miles of Mars has been designed by the Massachusetts Institute of Technology. Probe is intended to photograph Mars and return to Earth in two to three years, depending on the projection velocity.

SPACE REPORT. — Instruments aboard the solar probe, Pioneer V, have confirmed the existence of a giant tubular "ring current" of electricity flowing westward around the Earth, day and night. The current, estimated at about 5,000,000 amp., is about 24,000 miles across with its centre located some 36,000 miles beyond the Earth.

WOOMERA OPPORTUNITIES. — Applications are invited for 16 new positions on the scientific and technical staff of W.R.E., South Australia, arising from the increasing potential of Woomera as a space tracking and communication centre in collaboration with the U.S. space-programme.

ANGLO-AMERICAN CONVERSATION.—Sir Thomas Sopwith (L) talking with Mr. L. C. McCarty at the R.Ae.C. Dinner to 1910 Pioneers on Apr. 26. Mr. McCarty, a veteran pilot, is European representative of the McDonnell Aircraft Corporation who build the F4H-1 Phantom 2 Mach 2.4 twin-engined two-seat long-range interceptor for the U.S. Navy.

PRIZE FOR ILYUSHIN. — Sergei Ilyushin, Vladimir Kokkinaki (test pilot) and nine others have been awarded a Lenin prize in science and technology for the Il-18 turboprop airliner. According to a Russian source, versions of the Il-18 now in service carry from 83 to 111 passengers, and a 120-seat version is under development. The Il-18 is also now used by Aeroflot on some domestic all-freight services.

A.B.A.C. CONVENTION.—The Association of British Aero Clubs is organizing a Summer Convention at R.A.F. Thorney Island on Saturday, May 21, starting at 14.30 hrs. To be held in conjunction with the Thorney Fair, it will include both a static aircraft display and a flying programme.

CESSNA RECORD.—Export sales of the Cessna Aircraft Co. reached $1,185,000 during March, the largest export sale figure for any single month in the history of the company. The previous highest month was February, 1958, when sales totalled $863,000.

UNDER WRAPS.—A complete airframe of the Bristol Type 188 research aircraft—suitably hidden under wraps—on its way from Filton to Farnborough on May 4. At R.A.E. it is to undergo an extensive programme of structural testing.

Commercial Aviation Affairs

ELECTRA ORDER.—Two 84-seat Lockheed Electras have been ordered by Aerolineas Peruanas (APSA) for delivery in May and June, 1961. They will be operated from Peru north to Panama City and south to Buenos Aires. The total of Electra orders is now 174.

FRIENDSHIP DEMONSTRATION.—A Fokker F-27 Friendship was demonstrated in this country this week, primarily to the various independent airlines. It was the first occasion on which a Friendship had been demonstrated by the makers in Britain.

VISCOUNTS FOR SALE.—The latest *Market Report* of the Aircraft Exchange lists for sale two Viscount 755s (as delivered to Cubana) and two Viscount 708s (the Air France model). The Viscount 755s are priced at $900,000 with spares and the 708s at $500,000.

ALITALIA.—The first of six Conway-engined Series 40 DC-8s was delivered to Alitalia on Apr. 30. It will be put into operation on the Rome-London-New York route on Jne. 2. On Apr. 29 the first of four Caravelle IIIs was delivered and this type will go into service on the London-Rome route on May 23.

AIR-SEA EXCHANGE. — Cunard, which recently acquired a majority interest in Eagle Aviation, is discussing with B.O.A.C. and other transatlantic carriers the possibility of air-sea exchange tickets to facilitate the means by which passengers may travel one way by sea and the other by air.

MORE F-27s.—Five more Friendships have been purchased from Fokker in two airline re-orders announced last week. Pakistan International has increased its order from three to five (retaining an option on three) and N.Z.N.A.C. has doubled its order from four to eight (reducing the option to three). Deliveries of all the new aircraft are scheduled for the summer of 1961.

COMPUTOR LABORATORY.—The F.A.A. has opened a computor laboratory at Atlantic City for experiments in new operational concepts and improvements for the computors which are being installed at A.T.C. centres in the U.S.

T.A.A. HELICOPTERS.—Two Hiller 12E three-seat helicopters have been purchased by Trans Australia Airlines, which has a fleet of older Hillers in service already. They are used for charter flying and particularly geophysical survey and mineralogical exploration.

INTERNATIONAL EFFORT.—The newly certificated Lockheed LASA 60, which is to be built in Italy and Mexico.

KC-135A FOR THE F.A.A.—The F.A.A. has ordered and will receive in June a Boeing KC-135A for use in checking air navigational aids. Largest aircraft in the F.A.A. fleet, the KC-135A will cost about $2½ million and will supplement the Martin B-57s which are now being used in the Agency's flight inspection programme.

BRIGHT DISPLAYS ORDERED.—The F.A.A. has ordered 38 more radar bright display systems for use at air traffic control centres handling a heavy volume of en route traffic. They will be installed at 21 centres; 10 centres and four airports already have this equipment.

E.C.A.C. AGREEMENT.—A multilateral agreement relating to certificates of airworthiness for imported aircraft was signed in Paris last month by 10 member states of the European Civil Aviation Conference. The agreement is expected to facilitate the interchange of aircraft and crews between airlines of different countries. The signatories were Finland, France, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden, Switzerland and the U.K. Belgium will also sign shortly.

NEW SERVICE.—Airlines (Jersey), Ltd., has obtained approval to operate a normal scheduled service between Exeter and Dublin from Jne. 24.

NEW AUSTRALIAN NAMES.—New names are now being used by two of the subsidiary airline operating companies of Ansett-ANA. Butler Air Transport has become Airlines of New South Wales and Guinea Airways has been re-named Airlines of South Australia. A third subsidiary, Queensland Airlines, continues unchanged, but an alteration in the title of the parent company, Ansett-ANA, is likely soon.

TRAVEL SURVEY.—Following a pilot operation, the International Travel Market Research Council (67, Rue de la Loi, Brussels), is now starting a West European Survey. Companies and institutions may become subscribers to or members of the Council and receive the confidential reports. The Air Research Bureau is a founder member of this non-profit making organization.

K.L.M. OCCASION.—The third K.L.M. DC-8 will be flown to London Airport on May 17 for a naming ceremony by Air Commodore Sir Frank Whittle. The date is the 40th anniversary of the first K.L.M. service between London and Amsterdam, flown in a D.H.16 by Capt. H. "Jerry" Shaw. The DC-8 fleet is being named after pioneers and inventors, including Edison, Fokker, Orville Wright and Marconi, in addition to Whittle.

News About People

SPERRY DIRECTOR.—Mr. M. L. Jofeh, O.B.E., manager of the Industrial Division of the Sperry Gyroscope Co., Ltd., who has been appointed a director of the company.

ALITALIA APPOINTMENT.—Mr. Giorgio Mariani has been appointed Alitalia general manager for the U.K. and Ireland. He will be based in London, together with Mr. F. Casale, the regional manager for Europe.

A.D.A. PRESIDENT. — Mr. W. Brining, a director of Almin, Ltd., has been elected president of the Aluminium Development Association for the period 1960-61.

CAMBRIAN APPOINTMENT.—Mr. Richard Ashley Hall, F.B.I.M., has been appointed to the board of Cambrian Airways. Deputy chairman of the Jensen and Nicholson Group Ltd., and chairman and managing director of John Hall and Son, he played a prominent part from 1927 onwards in the formation of the Bristol and Wessex Aeroplane Club, of which he is now president. He was also closely concerned with the development and management of Bristol Airport when a member of the Bristol City Council, and was a founder member and first chairman of the Aerodrome Owners Association.

GANNET ACCIDENT.—We regret to record the deaths of Mr. R. A. V. Hazlehurst, test pilot, and two flight development engineers, Mr. P. Field and Mr. E. P. Potter, of Bristol Siddeley Engines, on Apr. 26 last. They were killed when their M.o.A. Gannet operated by the company crashed in a field approximately a quarter of a mile short of the runway at Filton, Bristol. Joining Bristol Siddeley as a test pilot in January, 1957, Mr. Hazlehurst had approximately 7,800 flying hours in some 30 different types to his credit. He was awarded the D.F.C. in 1944.

Correspondence

Back to Sea Travel—But not by Flying-boat

I SYMPATHIZE with Mr. Angus Trevannek's friend (Apr. 29), but it is wishful thinking that the flying-boats will make a comeback.

The trend today is to build larger and larger, faster and faster, aircraft until Mr. Trevannek's friend will have the pleasure of being hurtled through the air at speeds up to 6,000 m.p.h. As the cheerful ground hostess helps you aboard the aircraft she will say "Don't be nervous, sir, you'll be landing at New York in 30 minutes."

One consolation, however, is that by the time these aircraft are in service it will take two days to get from London Air Terminal to London Airport, with a night-stop at an hotel on the way.

No doubt all this is the reason the shipping companies are taking such an interest in civil aviation. If they can hurry this process along, the air-travelling public will eventually decide to go by sea.

Neston, Wirral. B. COWARD.

The Non-existent Super Electra

I SHOULD like to comment on a letter by Mr. Powell of Nairobi regarding the fabulous Howard Hughes (Apr. 15).

There never was a Lockheed Super Electra; there were Lockheed 10s, 10As, 12s and 12As, but the 14 was the forerunner of the famous Hudson. The 14's existence was mainly due to the mods. and engineering done by Trans-Canada Air Lines, in the same manner that they cleaned up the Viscount for its general acceptance on the civil market.

At this point I should make it clear that I have never had any connection with T.C.A., but credit should be given where it is long overdue.

Where Mr. Powell makes reference to Mr. Hughes' various V.I.P. aircraft he has omitted a Lockheed Constellation, model 749, manufacturing number 2671, which was purchased by B.O.A.C. via the Lockheed Aircraft Corporation. When delivery was taken it had less than 80 hours and was furnished in executive style, its U.K. registration being G-ANNT. Its present owners may be Avianca.

As Mr. Powell is usually faultless in his comments and histories of aircraft, perhaps he will forgive me for drawing these points to his attention, but the record must be kept straight and correct.

Richmond, Surrey. HUGH K. BATCHELOR.

The Significance of "Y"

MAY I point out regarding the word "autogyro" that it is quite improper for anyone to make use of this word spelt with an "i." In this form it has been the registered trade name of a well-known company in the aircraft industry for many years past.

If one wishes to express the idea of a machine capable of autorotation and not the product of the aforesaid well-known company then AUTOGYRO is your word.

Tring, Herts. NORMAN HILL.

41 Squadron's History

I AM re-writing the history of No. 41 Squadron and wish to borrow photographs and items of interest from past members of the Squadron. I would also like past members to write to me recounting their experiences on the Squadron.

No. 41 Squadron,
Royal Air Force,
Wattisham, Ipswich,
Suffolk.

M. GILL.
(Flight Lieutenant, R.A.F.)

Tracing Lysanders

FOR the past two months I have been collecting material with a view to compiling a history of every individual Westland Lysander which was built.

Can you please help me in this difficult but interesting task by allowing me to ask readers, who can do so, to give me ANY information on this aeroplane.

Wynegem, Belgium. P. DE MAEYER.

Groundabout

The Counter-Deterrent. Just in case you missed this "Beachcomber" gem in the May 2 *Daily Express*:

Asked if he thought his Lunatik could be converted, at a cost of a few hundred millions, into a counter-deterrent, the sage* of Waggling Parva said: "Certainly, if our potential aggressor were Saturn or the Milky Way."

A Government spokesman commented: "Strabismus, being a man of pure science, is somewhat out of touch with contemporary thought on defence strategy. We must always keep one jump behind, so that the uselessness of each weapon may be fully demonstrated before it is discarded."

* Dr. Strabismus (Whom God Preserve).

*

Points of Return. "The aircraft later made a three-point landing on one engine."—*London Evening News*. Thanks to the makers' foresight in marking on their engines the three points on which an unscheduled landing should be made by a careful pilot.

*

Any Questions? "You're half a pound overweight" an airline passenger was told when his luggage was weighed at Atlanta Airport, U.S.A. The passenger shrugged, opened his suitcase, took out a 2-ft. long salami, cut off half a pound and ate it before boarding the airplane.—*B.E.A. Magazine, April.*

*

Enveloped. As though in answer to my recent ignorant speculation about the limitations of anti-aircraft missile defence of ships, "Convairiety" quotes an admiral's statement that the U.S.N. will depend upon "envelopes" (that word again!). The first "envelope" will be provided by interceptor aircraft, the next by long-range missile Talos, then the medium-range Terrier will have a go, then the short-range Tartar. If these fail, there remain batteries of what I suppose would now be called "steam" guns, shell-firing jobs. Finally, the defenders can turn to the ship's padre, as by this time they will need all the help they can get.

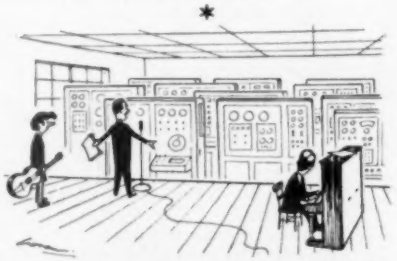
*

After the Cold War, came the Thor? My old friend "Van" Hattum, of the Royal Netherlands Aero Club, reflects sadly in rhyme:—

Thor Without a Spring

Here I sit and there you stand,
A Thor that sticks to solid land,
Whose spark, we hope, will not be fired.
No cockpit up aloft for me
From which the anxious earth to see;
I wish I had retired. . . .
O towering tube filled to the brim
With nothing, yet must be in trim
And clean from tip to tail.
While dust will gather at your feet
My misery is most complete;
I won't even see you fail. . . .

*



"The BBC presents 'WORKER'S PLAYTIME!'"

by Gren

Industry Record

A New Filtration Test House

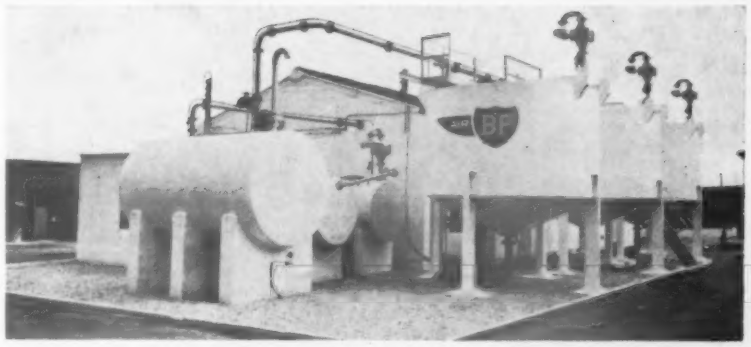
To date, there has been no universally laid down test procedure for filtration equipment employed in the quality control of aviation fuels. Therefore, before Air BP accepts microfilter and water separator units for service, a specimen of each model selected is subjected to a series of tests which have been established as the result of experimental work.

The company's tests occupy three stages. First there are laboratory tests which have the primary object of assessing the efficiency of the filter medium used in the microfilter and water separator equipment. Next follows a series of full-scale rig tests to assess the performance of the complete units up to their rated flow. Lastly there are field tests in which the unit is subjected to conditions which it will meet in aviation service.

Initially, the full-scale rig test work was undertaken at the BP Research Centre at Sunbury-on-Thames where a test rig with a capacity of 260 Imp. g.p.m. was constructed. Subsequently, however, with the increased fuelling rates and larger quantities of fuel required by the new turbine-engined aircraft, the microfilter equipment was required to perform at a higher efficiency and under more exacting conditions.

To meet these new requirements an Air BP Filtration Test Unit has been developed and installed at the Flight Refuelling, Ltd., airfield at Tarrant Rushton. Designed for an optimum flow rate of 500 Imp. g.p.m. and capable of being uprated to 700 g.p.m., it is one of the most advanced rigs of its type in existence.

Test sequences which are undertaken with the rig include resistance to flow, filtration and water separation efficiency, simulated life tests, and backflushing (reverse flow) experiments. For the efficiency and life tests, artificial contaminants and water can be injected into the system at controlled rates and concentrations.



The rig building, which is divided into three separate sections comprising pump house, main circuit and control panel, and component examination unit.

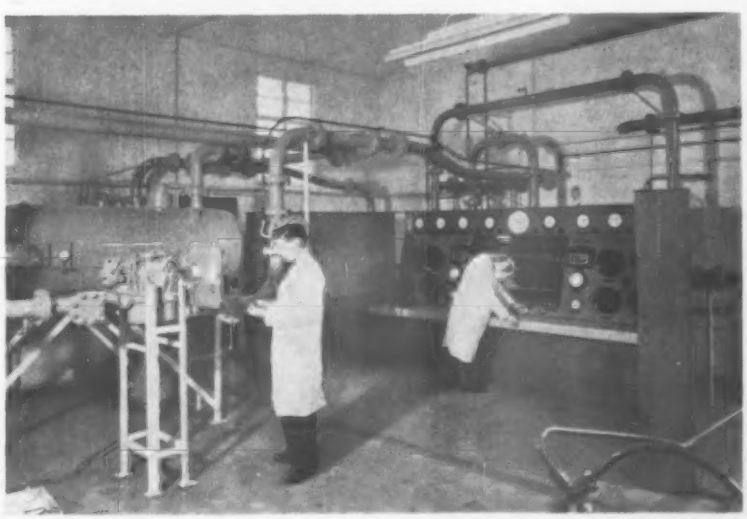
The complete unit comprises two main buildings; one houses the full-scale rig and the other a small laboratory. The rig building is divided into three separate sections consisting of a pump house, main circuit and control panel, and a component stripping and examination unit.

The basic rig circuit consists of three 5,000-gal. storage tanks which are connected to a common pipe feeding a centrifugal pump driven by a variable-speed diesel engine. From this pump fuel is fed through one of three testing, mixing or cleaning circuits before returning to any one or all three main storage tanks. In addition there is the back-flushing circuit which discharges into a separate 3,000-gal. storage tank.

Overall rig operation can be controlled from a central control console by one operator. In the centre of the main control panel a miniature electric circuit illuminates to show when a particular circuit has been selected and is in operation. Other controls include various pressure gauges, flowmeters, pump selectors, rotameters and water injection system control valves.

Laboratory tests include microscopic analysis of slides for particle counting, water content determinations, and measurement of interfacial tension.

A general view of the control panel of the new Air BP test unit at Tarrant Rushton.



Anglo-American Agreement

An agreement has been concluded between Ferranti, Ltd., and the Bendix Aviation Corporation for the sale in the U.S.A. of the new Ferranti systems of machine tool control developed at Edinburgh. These were first introduced at the 6th European Machine Tool Exhibition in Paris in September, 1959, and comprise the transistor/hydraulic continuous-path machine tool control equipment, numerical position control equipment and inspection machines.

Bendix will market and service the British-built systems throughout the U.S.A. and will set up a computer centre initially in Detroit to supply magnetic tapes for this equipment. The inspection machine is to be exhibited by Ferranti, Ltd., at the forthcoming British Exhibition in New York (Jne. 20-26).

Magnetic Material Production

British Insulated Callender's Cables, Ltd., has announced the formation of a new company, Telcon Metals Limited. This company, centred at Crawley, will assume responsibility for all the activities of the Metals Division of The Telegraph Construction and Maintenance Co., Ltd. These cover the manufacture of Telcon magnetic materials and other special alloys used in the electrical and engineering industries.

In addition to operating the factory at Crawley, Telcon Metals, Ltd., will control Magnetic and Electrical Alloys, Ltd., Burnbank, Hamilton, Lanarkshire; Telcon-Magnetic Cores, Ltd., Chapelhall, Lanarkshire; Temco, Ltd., Lydbrook, Glos.; and Toolpro, Ltd., Ilford, Essex.

A New Differential Counter

Counting Instruments, Ltd., have recently introduced a new differential electric counter, Type 1400. It is designed to accept two trains of pulses, one adding and the other subtracting, and indicate the result. This is achieved by having two modified versions of their Series 100 mechanisms driving a train of wheels through a specially designed differential.

The initial design was developed to meet the requirements of aircraft having flight refuelling facilities and where it is necessary at all times to have an accurate indication of the fuel remaining. In this application two fuel flowmeters are used, one measuring the fuel being used

Industry Record . . .

by the engines and the other the fuel which is pumped into the aircraft's tanks during flight refuelling.

Since these two functions can occur at the same time a counter was required which would accept pulses from the two flow meters and present to the pilot a continuous indication of the fuel in the aircraft's tanks.

Two push buttons are located below the figures which enable the counter to be reset to zero or set to a predetermined figure. These buttons are two-stage switches and control fast and slow adding and subtracting pulses.

The method of reset is to push either the adding or subtracting buttons fully home, when fast pulses will be fed to the counter. When the approximate reading is reached the button is released and by pushing it half-way home single pulses can be fed to the counter. Reset pulses are obtained from a circuit which is built into the counter.

Test Rig for Boeing 707s

A new type of ground unit for testing the alternators and electrical systems of the Boeing 707 has been produced for B.O.A.C. by Aircraft Ground Equipment, Ltd., of Blackswarth Road, Bristol. According to the company, the test unit is unique in this country; its prime mover can provide power for testing alternators up to four times its own rating. It will produce infinitely variable loads up to 120 kVA. without the need for the load banks of resistances normally used to dissipate power.

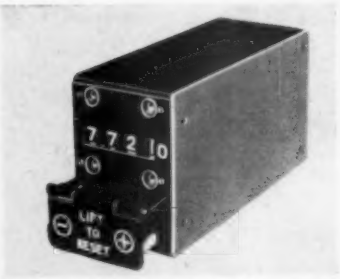
Known as the AGE "feed-back" test rig, this unit consists of a prime mover which drives two aircraft alternators at a constant 6,000 r.p.m. via a gearbox. Current from the alternator on test is passed through aircraft test circuits to the second alternator, which then runs as a motor and helps drive the first alternator. The output from the test alternator thus provides much of the power for its own drive; the prime mover makes up the balance. In the unit produced for B.O.A.C. the prime mover is a 30 h.p. electric motor, but a diesel unit could be installed if required. It is claimed that this "feed-back" principle results in a lighter, cheaper and less bulky test rig than those normally used.

Every effort has been made to ensure that the test unit is foolproof in operation. Interlocks are incorporated so that only the correct starting and operating sequence can be used. The equipment will shut down automatically if alternators or circuits are overloaded or if there is a failure in blast cooling air, a fall in gearbox oil pressure or malfunction in the aircraft system under test.

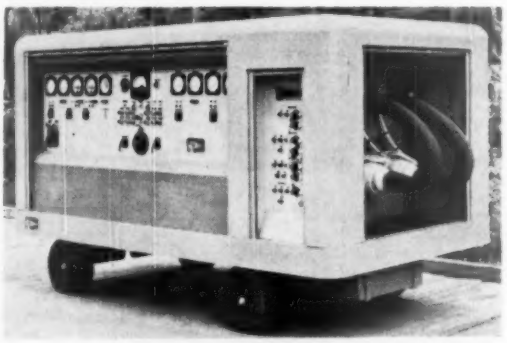
The unit is mounted on a four-wheeled chassis and has turntable steering and a parking brake. It is enclosed in a sheet steel housing with sliding roller-shutter doors and is designed for all-weather operation.

A constant-frequency unit has been supplied to B.O.A.C., but variable-frequency machines are also available. Mobile or static units can be produced suitable for the electrical systems of virtually any modern aircraft.

The price of this test unit, excluding aircraft alternators, is under £6,000. Its distribution in the United States is to be handled by the United Manufacturing Co., of Hamden, Connecticut.



The new differential electronic counter produced by Counting Instruments Ltd. Weighing 14 oz., it has an operating speed of five counts per second.



Aircraft Ground Equipment, Ltd., have produced this "feed-back" test rig for aircraft alternators and electrical systems.

PUBLICATIONS RECEIVED

Warplanes of the World.—Military aircraft in production and service throughout the World; a survey with photographs, silhouettes and text in the customary A.B.C. treatment. By John W. R. Taylor. 96 pp.; 7¼ in. by 9¾ in. Illustrated. Ian Allan Organisation Co., Ltd. Price 10s. 6d.

Aviation Directory of Canada, 1960.—A comprehensive directory of Canadian aviation, including sections on the aircraft industry, air transport, military aviation, sources of supply and services, and a biographical "Who's Who." Edited by Robert G. Halford. 199 pp.; 8½ in. by 11¾ in. Farm Equipment Publishing Co., Ltd. Price $5.

There Shall Be Wings.—An informal history of the Royal Canadian Air Force. By Leslie Roberts. 290 pp.; 6½ in. by 9¼ in. Illustrated. George G. Harrap and Co., Ltd. Price 21s.

The Other Side of the Moon.—Details of Sputnik III and its orbit, together with photographs of the other side of the Moon and an explanation of how they were obtained. Translated from the Russian by J. B. Sykes. 40 pp.; 8¼ in. by 10½ in. Illustrated. Pergamon Press, Ltd. Price 10s. 6d.

The British Journal Photographic Almanac, 1960. Well-known annual in its customary format; contents include a chapter on photographing aeroplanes by Leslie Sansom, chief photographer of Vickers-Armstrongs. Edited by Arthur J. Dalladay, A.Inst.P., F.I.B.P., F.R.P.S. 620 pp.; 5 in. by 7¼ in. Illustrated. Henry Greenwood and Co., Ltd. Price 8s.

Mount Up With Wings. An autobiographical account, by the one-time Press secretary at Heston Airport, of pre-War private flying and War-time experiences in the A.T.A. By Mary de Bunsen. 224 pp.; 5½ in. by 8½ in. Illustrated. Hutchinson and Co. Price 21s.

Aviation Calendar

May 17

London.—R.Ae.S. Historical Group lecture by Sir Thomas Sopwith, at the Institution of Mechanical Engineers, Birdcage Walk, S.W.1, at 18.00 hrs.

May 19

London.—R.Ae.S. 48th Wilbur Wright Memorial lecture "Mathematics and Aeronautics," by Prof. M. J. Lighthill, at the Institution of Mechanical Engineers, Birdcage Walk, S.W.1, at 18.00 hrs.

May 20

Wolverhampton.—R.Ae.S. Birmingham and Wolverhampton Branch A.G.M., at 19.30 hrs.

May 25

Hatfield.—R.Ae.S. Hatfield Branch A.G.M., in the de Havilland Restaurant, at 18.15 hrs.

London.—R.S.A. lecture, "The Prospects and Problems of Air Transport," by P. G. Masefield, at the Royal Society of Arts, John Adam Street, W.C.2, at 14.30 hrs.

May 28

Perranporth.—Cornish Gliding Club National Gliding Week; until Jne. 6.

Tebay Gill, Westmorland.—Lakes Gliding Club National Gliding week; until Jne. 6.

Portmoak, Nr. Kinross.—Scottish Gliding Union National Gliding Week; until Jne. 6.

June 6

Hucknall, Notts.—R.A.F.A. Air Display, Hucknall Aerodrome, at 12.30 hrs.

June 10

London.—R.Ae.S. Rotorcraft Section lecture, "Helicopter Vibration," by Dr. J. P. Jones, in the Library, 4 Hamilton Place, W.1, at 18.00 hrs.

Company Notices

NEW COMPANIES

Khedery (Near East), Ltd. (655,418).—Private co. Reg. Apr. 5. Cap. £100 in £1 shs. Air, sea and road transport and commission agents, etc. Directors: Charles E. Mills, 8 Hatherley Road, Kew Gardens, Surrey, and Albert A. H. Selwood, 26 Windermere Road, W.5. Sec.: Dora M. Strickson. Sols.: Mills Lockyer and Co., E.C.2. Reg. off.: 12 Coleman Street, E.C.2.

Petroleum Services (Middle East), Ltd. (655,809).—Private co. Reg. Apr. 7. Cap. £80 in £1 shs. At the date of incorporation, the basic proportion of the share-holding companies was: BP Exploration Co., Ltd., Shell Petroleum Co., Ltd., Compagnie Francaise de Petroles and Near East Development Corporation with 23.75% each and Participation and Exploration Corporation with 5%. Sols.: Bischoff and Co., E.C.2. Reg. off.: 214 Oxford St., London, W.1.

Teddington Centreless Grinding, Ltd. (655,814).—Private co. Reg. Apr. 7. Cap. £500 in £1 shs. Precision, mechanical, motor, aeronautical, electrical and oil fuel engineers. Directors: Gerald N. Burgess, Old Corbie, St. Georges Hill, Weybridge, Surrey, and Albert J. Corbett, 74 Garden Road, Walton-on-Thames, Surrey. Sec.: Albert J. Corbett. Reg. off.: 121 Munster Road, Teddington, Middlesex.

Firstin Fleet Services, Ltd. (656,204).—Private co. Reg. Apr. 12. Cap. £100 in £1 shs. Operators of shipping, air transport and road transport services. Sec.: Gordon V. Graeme.

Personal Notices

BIRTHS

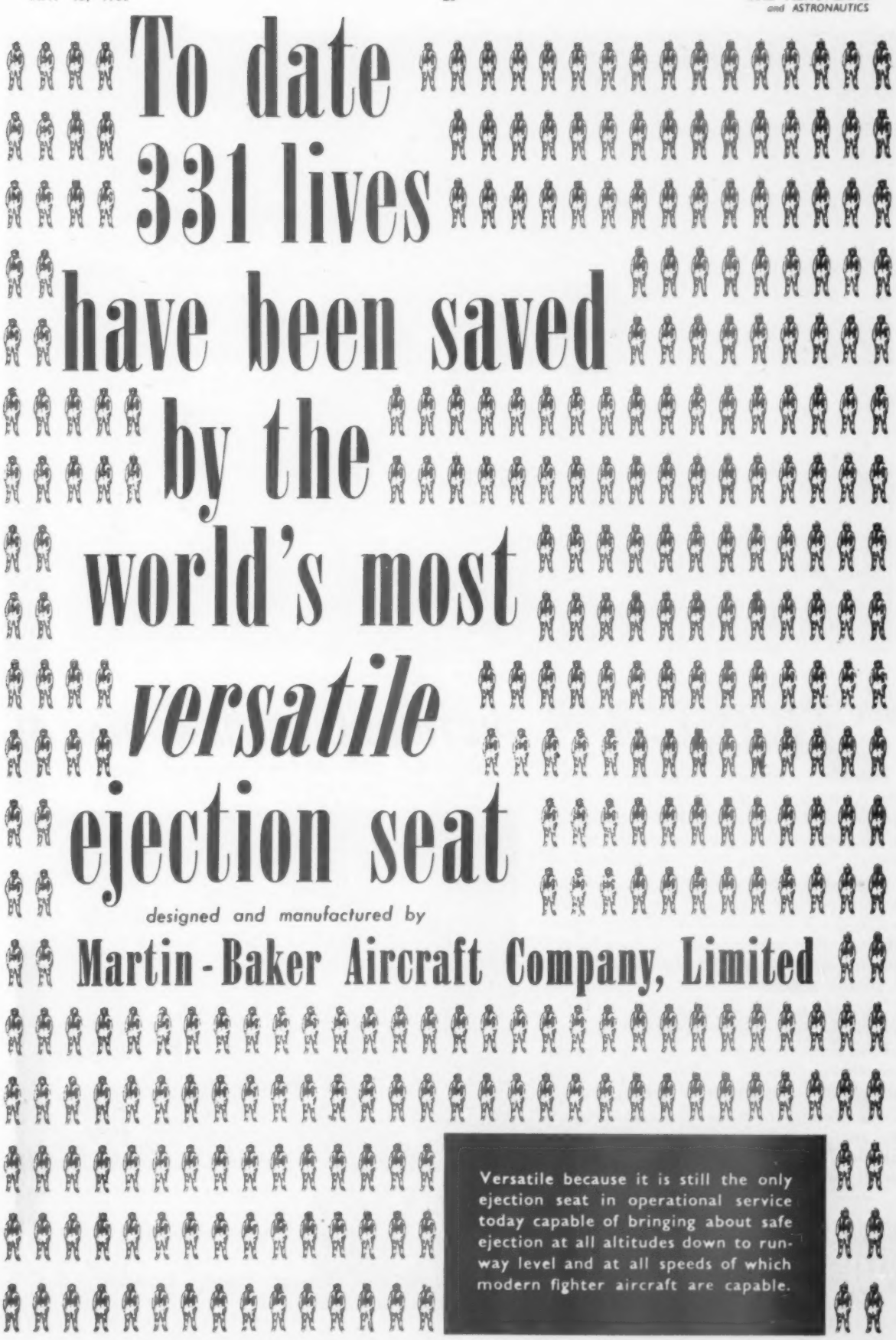
Beale.—On Apr. 27, at Pembury Hospital, to Christine, wife of Sqn. Ldr. J. W. Beale—a son.

Chance.—On Apr. 24, at Stratford-upon-Avon, to Diana (*née* Smart), wife of Flt. Lt. James Chance—a daughter.

Green.—On Apr. 26, at R.A.F. Hospital Wegberg, to Heather, wife of Sqn. Ldr. J. E. Green—a daughter.

McDougall.—On Apr. 29, at Bridlington, Yorkshire, to Joan (*née* Blanchard), wife of Capt. Donald V. McDougall, U.S.A.F.—a daughter.

Short.—On Apr. 27, at R.A.F. Hospital, Wroughton, to Patty (*née* Lee), wife of Sqn. Ldr C. J. G. Short—a son.



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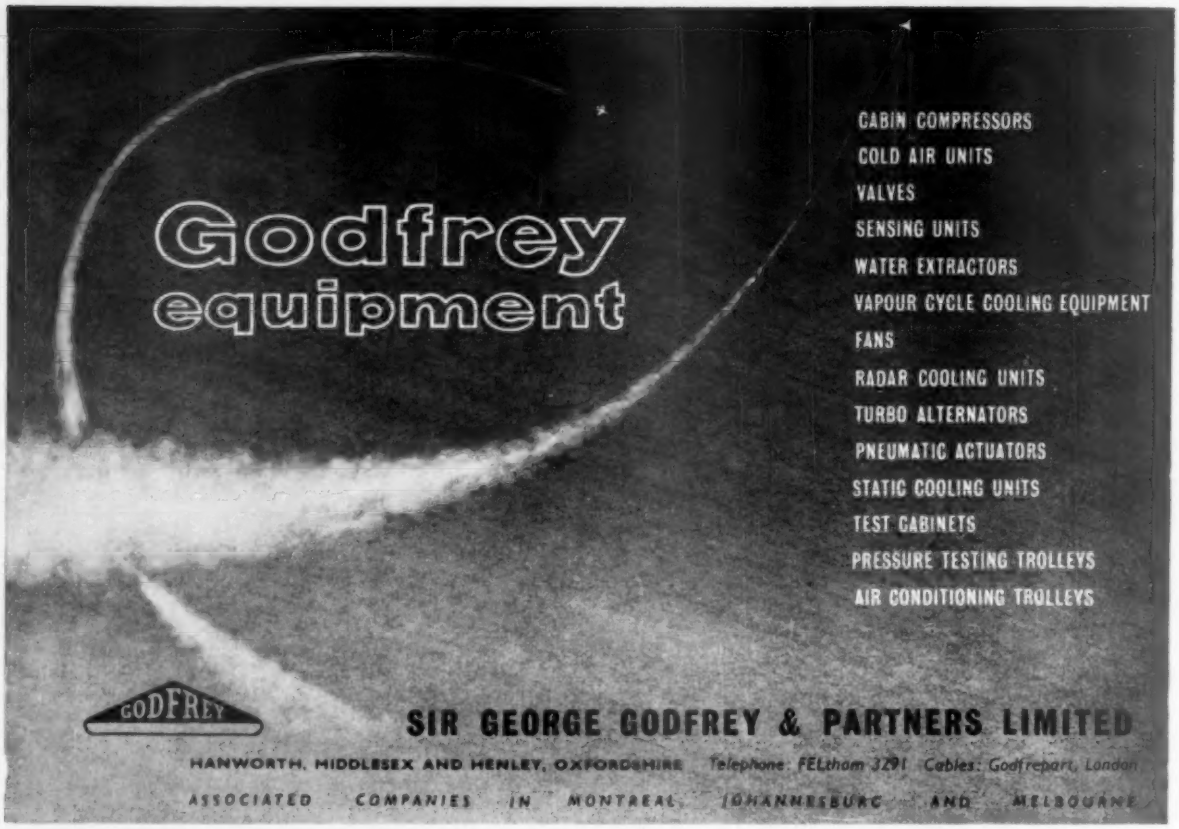

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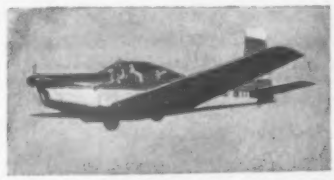

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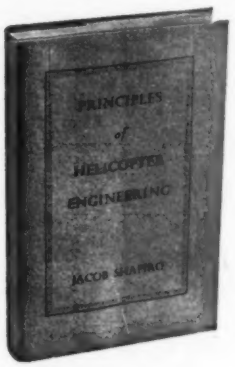

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INDEX TO ADVERTISERS

Name	Page
A	
Aero-Enterprises (Boreham Wood), Ltd.	25
Airwork, Ltd.	26, 28
B	
Blackburn Aircraft, Ltd.	15
Boeing Airplane, Co.	7
B.P. Aviation Services	16
British European Airways	27
British Refrasil Co. Ltd., The	Inside Front Cover
Burndept, Ltd.	22
C	
Cellon, Ltd.	14
CIBA (A.R.L.) Ltd.	27
Cross Manufacturing Co. (1938), Ltd.	26, 28
D	
De Havilland Engine Co., Ltd.	Front Cover
Desoutter Brothers, Ltd.	21
Dowty Rotol, Ltd.	12
E	
English Electric Co., Ltd., The (Aircraft Equipment Division)	17
F	
Fairey Co., Ltd., The	10, 11
Firestone Tyre & Rubber Co., Ltd.	6
Flight Refuelling Ltd.	20
G	
Garrett Corporation, The	5
Godfrey, Sir George, & Ptnrs., Ltd.	24
H	
Hall & Hall, Ltd.	4
Hawker Siddeley Aviation, Ltd.	26, Back Cover
Hunting Aircraft, Ltd.	13
M	
Martin-Baker Aircraft Co. Ltd.	23
Ministry of Aviation	27
Mole, Group Captain Edward	25
Monsanto Chemicals Ltd.	18, 19
N	
Norronafly	25
O	
Overseas Aviation (C.I.), Ltd.	27
R	
Rochdale Metal Products, Ltd.	28
Rye, Claude, Bearings	26
S	
Simmonds Aerocessories, Ltd.	Inside Back Cover
Smiths Aviation Division	2, 3
Standard Telephones & Cables, Ltd.	1
T	
Tinsley, H., & Co., Ltd.	4
V	
Vickers-Armstrongs (Aircraft), Ltd.	9
Vigors Aviation, Ltd.	25
W	
Westland Aircraft, Ltd.	8

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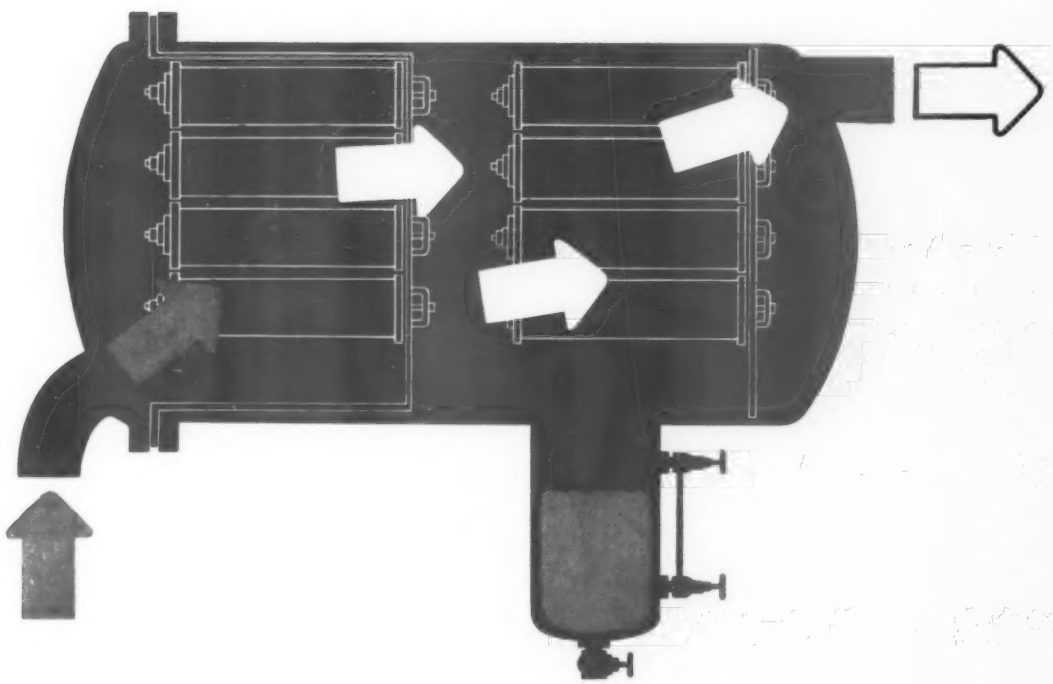

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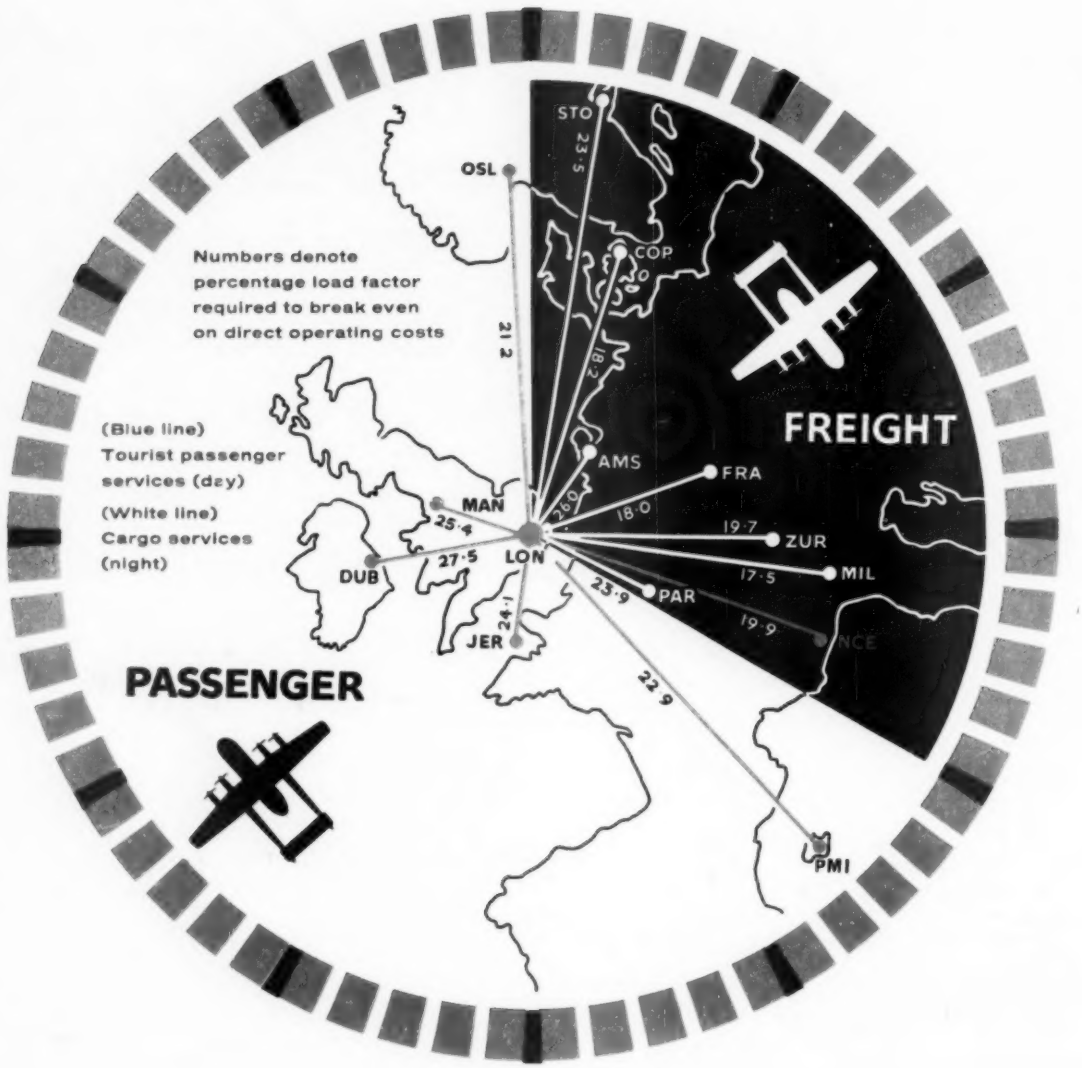

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